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FINAL

**Area-Wide Adaptive Management Plan
for Avoiding, Minimizing, and Mitigating Impacts to
Fluvial Geomorphology and Associated Environmental Resources
of the upper Salinas River and its Tributaries**

Re. Pankey Mine Conditional Use Permit
Paso Robles, San Luis Obispo
DRC2005-00193

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Upper Salinas River bed looking upstream within the proposed Pankey Mine Site, October 15, 2008

i. TABLE OF CONTENTS

ii.	EXECUTIVE SUMMARY	4
1.	INTRODUCTION	7
1.1	Purpose and scope of this Plan	7
1.2	Need for careful individual project design and area-wide adaptive management	8
1.3	Previous work	10
2.	PANKEY PROJECT REPORTS AND COMMENT LETTERS	11
2.1	Overview	11
2.2	Summary of individual documents	12
3.	HISTORICAL GEOMORPHIC ANALYSIS OF PANKEY SITE	20
3.1	Introduction	20
3.2	Summary of historical geomorphic analysis completed to date	21
3.3	Updated historical geomorphic analysis	21
3.4	Summary of long-term geomorphic trends on the upper Salinas River near the Pankey Site	40
4.	A PRELIMINARY UPPER SALINAS RIVER SEDIMENT BUDGET FOR AREA-WIDE SAND AND GRAVEL RESOURCES MANAGEMENT	44
4.1	Introduction	44
4.2	Geomorphic subreaches of the mainstem upper Salinas River	47
4.3	Estimated annual average natural bedload sediment supply to individual subreaches of the mainstem upper Salinas River	52
4.4	<i>Existing Conditions</i> mining-reduced sediment supplies and sediment bypass for individual subreaches of the mainstem upper Salinas River	64

5.	POTENTIAL PANKEY PROJECT IMPACTS TO SPECIFIC ENVIRONMENTAL RESOURCE AREAS	73
5.1	Introduction	73
5.2	Potential Project impacts on the upper Salinas River corridor	75
5.3	Potential Project impacts on the Vineyard Creek corridor	91
5.4	Potential cumulative impacts.	96
6.	AREA-WIDE ADAPTIVE MANAGEMENT MONITORING PLAN	97
6.1	Introduction	97
6.2	Existing sediment supply limitations for permitting proposed new instream mines	98
6.3	Required changes to current instream mining pattern to create continuous 50% bedload sediment bypass along the entire upper Salinas River corridor	101
6.4	Implementing an Area-Wide Monitoring and Management Plan . . .	102
6.5	S-1 Monitoring Plan	104
7.	REFERENCES CITED	108

- Appendix A.** Pankey Sand and Gravel Mine Project Preliminary Excavation Plan Permit Set (4 full-size sheets reduced to 11"x17" format).
- Appendix B.** Historical air photos of the upper Salinas River at the Pankey Site (reproduced from SDC 2007 Appendix A).
- Appendix C.** Recent air photos of existing and proposed instream mines sites along the upper Salinas River (Source: Google Earth).
- Appendix D.** Reservoir bulk sediment sample data from Glysson (1977).
- Appendix E.** Calculated unit area bedload sediment yield from reservoir sedimentation data of Glysson (1977).
- Appendix F.** Adjustment of Balance (2008) high and low curve bedload sediment yield estimates for lack of 1966-1969 data.
- Appendix G.** Longitudinal bed elevation profile showing locations of mines, road crossings, tributaries, and geomorphic subreach boundaries.
- Appendix H.** Additional aggregate mine information collected from County of San Luis Obispo, OMR, and City of Paso Robles.
- Appendix I.** Repeat cross-section survey data at bridges in Paso Robles vicinity (reproduced from SDC 2007 Appendix B).
- Appendix J.** County groundwater monitoring wells in sections that intersect the upper Salinas River recent alluvium.
- Appendix K.** Other recommendations for implementing area-wide monitoring and management plan.
- Appendix L.** Summary of information contained in planning and permit documents and annual inspection reports for existing instream mines collected from County of San Luis Obispo, OMR, and City of Paso Robles.

ii. EXECUTIVE SUMMARY

When instream sand and gravel mining greatly exceeds the natural sediment replenishment for long periods, there is potential for reducing river bed elevations to cause damage to public and private infrastructure, reduced groundwater storage capacity, and impacts to riparian vegetation and fish passage suitability. To date, none of these negative effects have apparently shown on the upper Salinas River in San Luis Obispo County. However, in responding to recent proposals to begin new instream mines on the Salinas, the Resource Agencies have raised questions about the general sustainability of the current instream mining practices on the river.

This Plan is prepared for evaluating the potential cumulative impacts of the proposed Pankey Sand and Gravel Mine Project (Project) near San Miguel. As currently proposed, the Project would extract as much as 96,000 CY/yr from the Salinas River bed and 9,500 CY/yr from the Vineyard Creek bed. In developing this Plan, **geomorph** and Oasis Associates built upon the technical work already completed by Sierra Delta Corporation (SDC) and collaborated directly with the Resource Agencies through a series of technical working group meetings and multiple rounds of back-and-forth review and response comments to a working draft document.

This Plan estimates the effects of existing permitted and proposed new instream mines on the sand and gravel (bedload) sediment supply to the mainstem river. First, the Plan divides the entire 30.22 river mile length of the alluvial mainstem river within San Luis Obispo County into five “geomorphic subreaches” reflecting the influence of major tributary sediment inputs on the natural and mining-reduced sediment supplies (Figure 1). Then, the Plan estimates the drainage area and natural bedload sediment supply tributary to the downstream ends of each subreach using ‘best available information’ unit area sediment yield (369 CY/sq mi/year) adapted from detailed analysis of the 1977 Santa Margarita Reservoir sedimentation study (Glysson 1977).

This Plan then totals the annual maximum extraction rates for all 17 of the existing permitted and proposed new sand and gravel mines in San Luis Obispo County. After eliminating two mines that are located off-channel, one mine that is closed, and one mine on a tributary stream that is of negligible size, the 13 remaining existing permitted and proposed new instream mines in the County together extract a total maximum annual permitted amount of 590,500 CY/yr. After eliminating two existing permitted instream mines that are located on tributaries far from the mainstem river, the resulting 11 existing permitted and new proposed instream mines in the Plan area together extract a total maximum annual permitted amount of 490,500 CY/yr. This Plan area amount is comprised of 265,000 CY/yr from eight existing permitted mines and 225,500 CY/yr from three proposed new instream mines.

This Plan then estimates the mining-reduced bedload supply to each subreach under existing conditions by subtracting the total annual permitted mining extraction occurring within and upstream from each subreach from the estimated natural sediment supply tributary to the downstream end of the subreach. This Plan also estimates the percentage of the natural bedload sediment supply that passes through each subreach without being extracted on an annual average basis – the percentage that “bypasses” each subreach under existing conditions. Current regulatory practice seeks to achieve minimum 50% bypass for individual instream mines sites and reaches. The resulting continuity of majority natural sediment transport through the corridor is believed would substantially maintain

geomorphic processes that support a healthy riverine ecosystem. At the same time, demand for local, affordable sand and gravel construction materials is expected to increase.

Thus, a sustainable area-wide sand and gravel resources management program would: (1) reduce maximum allowable extraction rates for existing permitted instream mines and prevent new instream mines occurring within subreaches that do not bypass 50% under existing conditions; (2) promote increases in maximum allowable extraction rates at existing instream mines and/or permit new proposed instream mines in subreaches that bypass significantly more than 50% under existing conditions; and (3) encourage development of other, off-stream sources of sand and gravel construction materials.

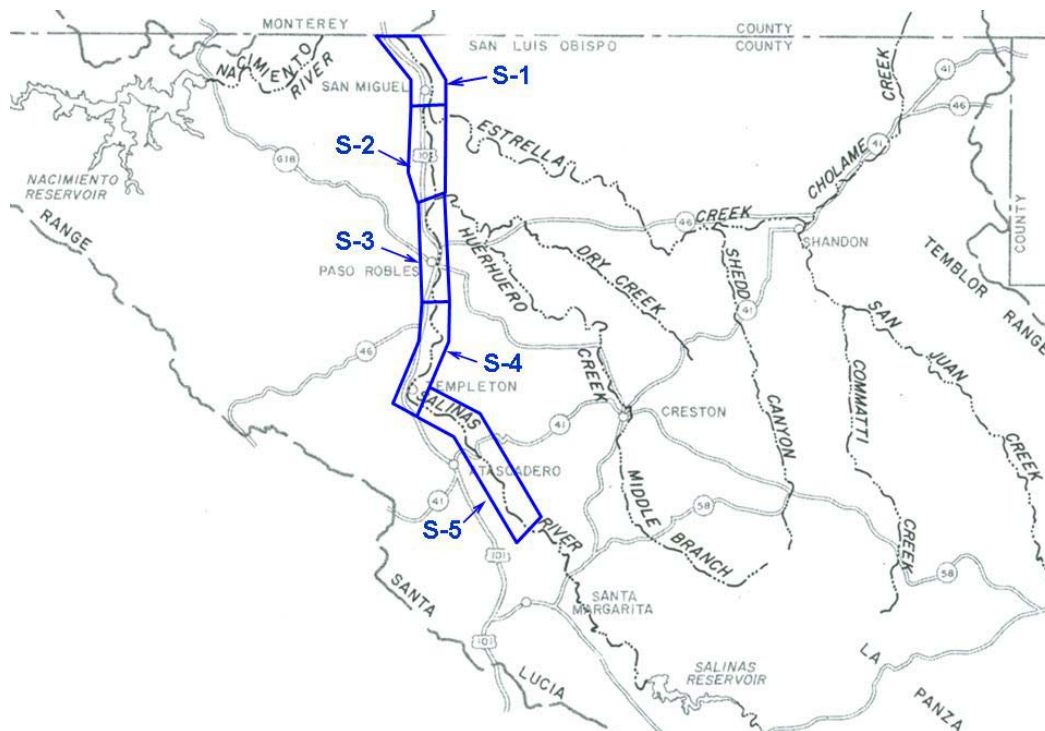


Figure 1. Geomorphic subreaches comprising the entire 30.22-mile-long alluvial portion of the mainstem upper Salinas River within San Luis Obispo County potentially subject to cumulative impacts of multiple existing permitted and proposed new instream mines. The proposed new Pehl and Weyrick instream mines are located in S-2 and the proposed new Pankey instream mine is in S-1.

Under existing conditions, the total annual maximum permitted extraction from the seven existing permitted instream mines located in or upstream from Paso Robles (220,000 CY/yr) is approximately double the estimated 109,012 CY/yr natural bedload supply. The 50% bypass requirement is unmet for subreaches S-4, S-3, and S-2. After the existing permitted instream mines have made just 50% of their annual maximum permitted extractions there is not enough natural bedload sediment supply remaining on the upper Salinas River to permit all of the 3 proposed new instream mines on Reach S-2 and Reach S-1 while still achieving 50% bypass.

Under existing conditions, the mining-reduced bedload bypass through Reach S-2 is only approx. 45,167 CY/yr, and Reach S-2 bypasses only 29% of its estimated natural bedload sediment supply. Therefore, the Pehl and Weyrick mine projects cannot be permitted as currently proposed while still achieving 50% bypass for Reach S-2.

The existing conditions mining-reduced bedload supply to Reach S-1 is approx. 389,576 CY/yr, and Reach S-1 currently bypasses 70% of its natural supply. There is an approx. 129,000 CY/yr 'surplus' of bedload material which can be extracted from Reach S-1 while still providing for 50% sediment bypass.

Conditioning the Pankey Project to limit its maximum annual extraction to 105,500 CY/yr, as it is currently proposed, would allow for approx. 54% bedload sediment bypass through Reach S-1.

This Plan provides a preliminary technical basis and suggestions for implementing an area-wide monitoring and management plan for achieving demonstrably sustainable management of the instream sand and gravel resource. The Plan outlines a recommended "S-1 Monitoring Plan" that would be implemented by Pankey Sand and Gravel for the 4.5-mile-long S-1 Reach that the Pankey Site is within. This Plan recommends the County appoint a single expert independent consultant (Environmental Monitor) to implement the S-1 Monitoring Plan. It's recommended that future detailing of the larger area-wide plan and actual implementation of the area-wide plan should be authored and coordinated by a Technical Advisory Committee (TAC) made up of County-appointed expert independent consultants and, if applicable, representatives of the existing and proposed future mine operators. The County and TAC should coordinate with the City of Paso Robles to gain cooperation with area-wide plan implementation because three of the seven existing instream mines on the mainstem river are within City jurisdiction.

1. INTRODUCTION

1.1 Purpose and scope of this Plan

An instream sand and gravel mining operation is proposed at the Pankey Sand and Gravel Mine Site (Site) located within and adjacent to the active channels and riparian corridors of the upper Salinas River and tributary Vineyard Creek. The Site has also been referred to as the Indian Valley mine site. The operation would occur within a 1,167-acre parcel at 4444 Indian Valley Road approx. 1/4 mile northeast of San Miguel, California. As currently proposed, the Pankey Sand and Gravel Mining Project (Project) would extract as much as 96,000 CY per year of channel bed material from two excavation areas totaling approx. 7,040-ft-long and 29.9-acres excavation area on the upper Salinas River bed and as much as 9,500 CY of bed material per year from an approx. 2,460-ft-long, 3.66-acre excavation area averaging about 60-ft-wide on the bed of Vineyard Creek. Appendix A contains preliminary excavation plan drawing (Permit Set) based on the currently proposed annual maximum extraction rates and the Project design recommendations and impacts avoidance and minimization measures contained in this Plan.

Bed material extraction can cause channel bed incision within and upstream and downstream from the excavation area, with potential associated impacts to channel form, bank stability, riparian vegetation, fish passage, and shallow alluvial groundwater. This Area-Wide Adaptive Management Plan (Plan) uses fluvial geomorphic analysis to estimate the physical impacts of the Project on bed elevations and bank stability and associated impacts to riparian vegetation, fish passage, and groundwater within and upstream and downstream from the excavation area. To prevent against Project impacts, this Plan recommends avoidance and minimization measures, including specific revisions to the maximum permitted extraction and excavation area boundaries shown in previously proposed versions of the Project.

This Plan also recognizes that the Project is but one of numerous existing active and proposed instream aggregate mines on the upper Salinas River and its tributaries. Accurate fluvial geomorphic analysis of the channel response to extractions within the Site requires systematic evaluation of all of the existing and proposed mines within proximity to the Site. In order to evaluate the Project's potential cumulative impacts within the larger affected system, this Plan first estimates *existing conditions* sediment budgets and percent of bedload sediment bypassed for individual geomorphic subreaches comprising the 30.22-mi-long mainstem alluvial upper Salinas River within San Luis Obispo County. The percent of bedload bypassed through successive river reaches is a measure of the continuity of sediment through the system. For protection of multiple environmental resources, the Resource Agencies generally seek to achieve minimum 50% sediment bypass through all individual instream mine sites and larger defined river reaches (e.g., NOAA 2004).

This Plan then factors in the annual maximum extraction amounts for the proposed new instream mines in the system including the proposed Pankey mine to estimate *proposed conditions* sediment budgets and percent sediment bypass for all of the subreaches as well as the Pankey site location. This way the Plan explicitly considers how much the existing permitted and proposed instream mines upstream from the Site may reduce the bedload sediment replenishment rate at the Site. To prevent against Project cumulative impacts, this Plan proposes an annual maximum extraction rate for the Pankey mine that provides for 50% bypass of the estimated natural bedload sediment supply on both Salinas River and tributary Vineyard Creek.

Finally, this Plan explicitly recognizes that implementing the recommended revisions to streamline the excavation area boundaries and setting maximum annual permitted extraction rates to exceed 50% of the estimated natural sediment supply may not comprise sufficient measures for preventing against deleterious Project impacts. This is for one because geomorphic and engineering analyses cannot resolve uncertainties in estimating the annual average sediment replenishment rate and the interannual variability of replenishment. Therefore, this Plan includes a detailed adaptive management type monitoring plan (S-1 Monitoring Plan) covering the entire 4.5-mi-long geomorphic subreach that the approx. 7,040-ft-long combined Salinas River Project excavation areas lie within. The S-1 Monitoring Plan includes repeat airborne LiDAR topographic data collection and repeat ground survey protocols for measuring groundwater table and bed and bank profile elevations with and near the Site and at other locations within and downstream from the geomorphic subreach (Reach S-1), especially, e.g., where there is near-channel and channel spanning infrastructure. Via semi-annual expert monitoring reporting requirements, the S-1 Monitoring Plan would mitigate any Project impacts by allowing for temporary mining delays and/or reductions in maximum extraction amounts, and/or requiring excavation area boundary modifications and physical restoration as direct mitigation.

This Plan provides a preliminary sediment budget analysis that is a technical basis for a comprehensive area-wide adaptive management type monitoring plan. It recommends conditioning the proposed Pankey Sand and Gravel Mine Project to allow 50% minimum bypass of bedload sediment through the Site on an annual average basis. It reviews potential impacts of the Project and outlines a recommended monitoring plan applying to the Project Site and the entire geomorphic subreach the Site lies within (Reach S-1). Reach S-1 is one of the five mining-affected geomorphic subreaches of the mainstem upper Salinas River. The recommended S-1 Monitoring Plan is intended also to serve as a prototype or template for implementing in the other subreaches as part of an area-wide adaptive management type monitoring plan.

1.2 Need for careful individual project design and area-wide adaptive management

Instream aggregate mining has had catastrophic effects on some California rivers (Scott 1973, Sandecki 1989, Collins and Dunne 1990, Kondolf 1997). The worst impacts occurred in river reaches where extractions were made for long periods at rates which greatly exceeded the natural sediment replenishment rate from the watershed. Cases have been documented where total mining extraction proceeded for decades at rates more than ten times the estimated supply. A notable regional example of mining-induced bed degradation and resulting severe infrastructure damage was on the San Benito River. Harvey and Smith (1999) documented as much as approx. 10 ft of bed degradation on the San Benito within the approx. 5-mi-long study reach from 1952 to 1995, resulting in failures of municipal pipelines and bridges. They estimated that instream aggregate mining operations had extracted approx. 2-3 times the natural river bed sediment replenishment over that period.

Among other things, Kondolf (1997) recommended limiting permitted sediment extraction rates to a percentage of the estimated natural sediment replenishment rate. NOAA (2004) recommended guidelines for aggregate mining within Salmonid-bearing streams in California which include limiting annual extraction to not more than 50% of the estimated annual replenishment rate.

An instream mining project that extracts 50% or less of the natural replenishment rate may still have some physical impacts within and some distance away from the excavation area. This is because the normal water year channel adjustment to an instream pit or trench may be a temporary reduction in river bed elevations within and extending some distance upstream and downstream from the excavation area. The resulting lower bed elevations theoretically decrease bank stability and increase the rate of local bank and island erosion. Therefore, a carefully designed instream mining project not only limits annual extraction to a percentage (e.g., 50%) of the estimated annual replenishment rate; it also includes an adaptive management type monitoring plan that may trigger delays or reductions in annual extraction and/or physical restoration as direct mitigation if the Environmental Monitor detects significant impacts to bank stability and riparian vegetation on or off-site.

However, it is often difficult in practice to completely attribute survey measured bed elevation changes and bank retreat only to the effects of mining when there are also present similar effects of natural channel processes. Indeed, even in the absence of anthropogenic effects, large ephemeral and intermittent meandering and locally braided sand and gravel bedded rivers like the Salinas are expected to exhibit some river bank and island erosion during normal winter high flows, and major channel adjustment and severe bank erosion during rare very high flows. River bank and island erosion are natural geomorphic processes which create and support diverse and self-sustaining riparian plant community. A carefully designed instream mining project that extracts only a percentage of the estimated annual replenishment rate will likely reduce bed elevations a relatively small amount compared to the pre-project bank height. Such lesser or minimized mining effects are generally difficult to isolate from the similar in scale and pattern effects of natural channel change, especially following relatively large floods.

Historical geomorphic analysis (Kondolf and Larson 1995) is one tool for developing a reasonable expectation for what kinds of natural channel change and what amounts of natural bed elevation and active channel width fluctuations will occur at a site or within a reach. Local bed elevation and active channel width changes far in excess of the natural range can often reasonably be attributed to local mining effects. Historical geomorphic analysis uses sequential historical air photos and maps, historical bed elevation data from stream gage records and bridge construction and maintenance records, and watershed context to document past changes and project future trends in river form and processes. For example, sequential air photos can be used to document channel changes and vegetation disturbance resulting from individual large floods. Available photos may also document relative channel stability and vegetation recovery during periods of drought. Some reasonably strong expectations often can be made about what kinds of channel change and amounts of bank erosion and active channel widening may be expected to occur during individual large floods or sequences of smaller floods. Similarly, for rivers with sufficient available historical bed elevation data, sequences of historical longitudinal bed elevation profiles often demonstrate the natural range of variation of bed elevations – natural fluctuations responding to large floods and intervening drought intervals, or heavy sediment runoff in the years immediately following wildfires (e.g., Hecht 1993).

While valuable general guidelines can be developed for avoiding, minimizing, and mitigating instream mining impacts, there will almost always be considerable scientific uncertainty and professional judgment underpinning even the most carefully designed instream mining project design. First, insufficient data usually exist for accurately estimating the natural sediment replenishment rate. Moreover, the majority of the estimated annual average sediment transport into a site is typically comprised of very large individual sediment runoff increments occurring in years with rare large floods (i.e., statistical outliers). Accordingly, extracting 50% of the estimated replenishment rate each year should outpace actual

replenishment in most years. Establishing a project maximum extraction depth measured from a fixed pre-project bed elevation, or redline depth, if set appropriately, can be an effective measure for preventing long periods of excessive extraction from occurring during drought periods.

Second, historical geomorphic analysis informs but does not strictly quantify the expected natural range of active channel width and bed elevation variation at a site. Separating mine effects from natural channel change effects will almost always require professional judgment by expert geomorphologists and riparian ecologists. Related to this is a third area of uncertainty in defining for individual projects an unambiguous and measurable detection threshold for identifying significant impacts to bed elevations, bank erosion rate, and riparian vegetation within and upstream and downstream from the excavation area. But unambiguous thresholds are required if monitoring data are intended to trigger uncontroversial delays or reductions in annual extraction when they indicate unacceptable impacts.

Finally, cumulative effects of multiple instream mining operations are often difficult to evaluate, especially when there are numerous pending applications for new mining operations, and some of the currently permitted mines are officially listed as temporarily inactive or in reclamation status. Moreover, while it is known that actual extraction rates are generally less than maximum permitted rates, actual extraction data are proprietary.

Given these uncertainties, and site- and reach-specific factors, an allowance of collaborative multi-disciplinary professional judgment is necessary for designing a successful instream mining project. Peer-review will improve project descriptions, impacts analyses, mitigation measures, and monitoring programs. Monitoring programs will be more effective if they are designed and executed by qualified expert geomorphologists, engineers, and/or ecologists whose professional judgments are credible. Cumulative impacts analyses will be more comprehensive and reliable if they include watershed-scale fluvial geomorphic analyses and lead to some explicit agreements about how much and where to limit watershed-scale channel bed degradation to amounts that are acceptable to all stakeholders and uncontroversial to measure.

1.3 Previous work

Substantial work has been completed by others. This Plan revises and repackages the useful elements of the existing information and adds new information. This Plan intends in general to improve consistency with standard practice, and specifically to address concerns and requests for additional information expressed by the Resource Agencies. Geomorphology related reports and comment letters are summarized in Section 2 of this Plan. Differences between information reported in this Plan and other information elsewhere in the project record may have resulted from an independent review of the existing information undertaken by **geomorph**.

2. PANKEY PROJECT REPORTS AND COMMENT LETTERS

2.1 Overview

Mrs. Janice Pankey Tannehill and Mr. Chad Pankey jointly applied for a Conditional Use Permit to mine aggregate at the Pankey (Indian Valley) mine site in 2005. At about the same time, applications were made by others to permit the proposed Viborg and Pehl mines. Sierra Delta Corporation (SDC) of Paso Robles produced a set of separate "Anticipated Geomorphic Effects" reports about each of these proposed instream mines in 2006. The County of San Luis Obispo retained Balance Hydrologics, Inc. (Balance) of Berkeley to peer-review the geomorphology reports. Balance issued a June 27, 2007 letter report citing several deficiencies in the original SDC geomorphology reports and requested several additional analyses be conducted, including preparing a monitoring plan for detecting potential project impacts. SDC issued an updated geomorphology report for the Pankey mine site dated October 5, 2007. SDC also issued updated geomorphology reports re. the proposed Pehl and Viborg mines at about the same time. Balance reviewed the updated SDC reports and issued a review comment letter dated November 2, 2007 indicating that the updated SDC reports adequately addressed the potential environmental impacts of the proposed mines.

The County of San Luis Obispo (County) finalized an Initial Study Checklist on March 26, 2008 and issued a Mitigated Negative Declaration for the Pankey mine Conditional Use Permit on April 3, 2008. California Department of Fish and Game (CDFG), California Regional Water Quality Control Board (RWQCB), and the U.S. Fish and Wildlife Service (USF&WS) issued comment letters in the subsequent months generally finding the geomorphology analyses completed to date inadequate for supporting a conclusion that the Pankey mine would have no significant impacts not otherwise mitigated by the current proposed monitoring plan. Generally, the resource agencies cited:

- Deficiencies in the consideration of cumulative impacts of multiple active and proposed instream mines present in the Salinas River system;
- Inadequate technical support for assertions that project effects on bank stability and riparian vegetation upstream and downstream from the excavation area would be minor;
- Lack of sufficiently detailed protocols and impact thresholds in the monitoring plan for assuring adequate adaptive management feedback for reliably mitigating potential project impacts; and
- Failure to follow USF&WS recommended protocols for biological assessments.

CDFG also issued a detailed comments letter on September 18, 2008 highlighting many of the above listed concerns for each of the proposed Pankey, Pehl, and Viborg mine operations and requesting additional information. SDC responded to the CDFG comments in a letter report to the County dated October 8, 2008. The SDC response provided many corrections and included a revised sediment budget estimate procedure framed within a preliminary discussion of potential cumulative impacts.

With many technical issues yet unresolved, the County issued a staff report to the Planning Commission on October 9, 2008 requesting on behalf of the applicant an extension of time to consider the requests for more information received from the resource agencies. On behalf of the applicant, Oasis Associates, Inc. (Oasis) retained **geomorph** to provide fluvial geomorphology services and convened an October 15, 2008 meeting at their San Luis Obispo office to discuss with resource agency personnel their specific concerns and develop

action items for preparing a revised geomorphic analysis report intended to address the outstanding technical issues. Working drafts of this Plan fulfilled an action item from that meeting.

2.2 Summary of individual documents

Because this Plan relies in large part on the available information contained in the substantial body of technical work completed to date, each of the pertinent technical documents in the project record are briefly summarized in chronological order below. Each document summary highlights information about the outstanding technical issues this Plan addresses.

Sierra Delta Corporation (SDC). 2006. Anticipated Geomorphic Effects of Instream Mining on the Salinas River and Vineyard Canyon Creek, San Miguel, San Luis Obispo County, California. Report to Indian Valley Sand and Gravel. (July 24, 2006) 21 p. plus appendices.

SDC prepared a report for the proposed site concluding the geomorphic effects of the proposed sand and gravel extraction would not be significant on or off-site because, according to SDC professional judgment:

- Field-observed current aggradation trends on both the Salinas River and Vineyard Creek would minimize any potential for excessive channel bed degradation and associated bank erosion; and
- The proposed 20-ft setbacks from river banks and vegetated islands would further minimize any potential for bank erosion and associated loss of riparian vegetation.

Balance Hydrologics, Inc. 2007. Re. Peer Review of Proposed Viborg and Indian Valley Mines Geologic Studies. Letter report to Mr. Jeff Oliveira, San Luis Obispo County. (June 27, 2007) 11 p.

Balance reviewed the original SDC geomorphology report for the Pankey mine, finding several deficiencies and needs for updates according to standard professional practice. Balance recommended SDC:

- Review and present sequential historical air photos of the site with a narrative description of the historical trends in channel change and responses to individual large floods and extended drought periods, etc.;
- Review stage-discharge data from nearby USGS gages to determine if the channel bed elevation fluctuations suggest any trends;
- Review any available repeat cross-section survey data from bridge maintenance records or other sources;
- Prepare a large-scale geomorphic map of the project site identifying existing geomorphic and vegetation features and topographic contours overlaying a base map of recent air photo imagery (8.5"x11" site maps are not large enough);
- Bulk sample sediment to document the typical grain size distribution of sand and gravel channel bed material within the proposed excavation areas and the grain size distribution of floodplain deposits away from the excavation areas;
- Estimate sediment replenishment rate for the site and consider cumulative effects on the Salinas River system resulting from multiple active and proposed instream mines;

- Substantiate SDC assertions that the Salinas River may be slightly aggrading or at dynamic equilibrium within the project reach, and that downstream effects of the mining are expected to be minimal;
- Support from literature or technical analyses the expectation that the proposed 20-ft setback from river banks and vegetated islands will minimize bank erosion potential on the Salinas River within and near the excavation area during a high flow event;
- Support for assertions that steep bank sections of Vineyard Creek will not be destabilized by the proposed excavation; and
- General guidelines and specific example of a monitoring plan for SDC to adapt to the project site;

Sierra Delta Corporation (SDC). 2007. Pankey mine geomorphic report supplemental information per items identified by Balance Hydrologics, Inc. Report to Mr. Jeff Oliveira, San Luis Obispo County. (October 5, 2007) 40 p. plus appendices.

SDC prepared a more comprehensive geomorphology report responding to Balance's recommendations. In general, SDC met the breadth and spirit of the recommended revisions. The SDC report included:

- An informative narrated sequence of historical air photos of Salinas River and Vineyard Creek within the project site;
- Maps made from scaled air photos comparing historical and current active channel planform of Salinas River and Vineyard Creek;
- Adequate summary of the evidently few available stage-discharge and repeat cross-section data;
- Grain size distribution charts for two bulk sediment samples from the channel bed, one each from Salinas River and Vineyard Creek;
- Preliminary sediment replenishment rate estimate based on direct drainage area ratio extrapolation from upper watershed sedimentation rate data (Glysson 1977, Knott 1976);
- Summary of small-scale GIS maps of generalized geology, land use intensity, precipitation, cover, and slope of the upper Salinas River watershed which provide helpful general context for evaluating the applicability of direct drainage area ratio extrapolation of upper watershed data to the project site;
- Incomplete tabulation of sediment extraction volumes from other instream mines in the Salinas River watershed yielding an inconclusive evaluation of potential cumulative impacts; and
- Proposed monitoring plan generally conforming to the example provided by Balance.

In responding to the Balance review comments and recommendations, the SDC report did not include:

- Conclusive discussion of the found stage-discharge and repeat bridge cross-section data;
- Evidence supporting the assertion that the Salinas River is currently aggrading within the project reach;
- Adequate cumulative impacts analysis incorporating all of the applicable active and proposed instream mine sites and either organized according to the reach-delineated sediment transport continuity planning concept suggested by Kondolf (1994) or informed by a discussion of Watson (2003);
- Detailed geomorphic evaluation of sequential historical air photos for developing a reasonable expectation of the natural background rates of bank erosion and

- riparian vegetation loss associated with natural active channel migration and widening during large floods;
- Technical rationale for adequacy of proposed 20-ft setback of excavation areas from river banks and vegetated islands for minimizing potential increased rate of bank erosion and riparian vegetation loss within and near the project reach; and
- Technical rationale for the estimated 2-ft maximum likely channel bed degradation upstream and downstream from the site resulting from channel adjustments to, e.g., maximum 5-ft deep (redline) trench excavated in the Salinas River, and the conclusion that 2-ft maximum channel bed degradation would not have significant impacts on upstream and downstream bank stability and riparian vegetation.

Balance Hydrologics, Inc. 2007. Re. Review of follow-up geomorphic addendums completed by Sierra Delta Corporation regarding the proposed PEHL, Viborg, and Pankey instream mining operations along the Salinas and Estrella Rivers. Letter report to Mr. Jeff Oliveira, San Luis Obispo County. (November 2, 2007) 2 p.

Balance reviewed SDC's October 5, 2007 supplemental geomorphology report finding it to be generally adequate for addressing the potential environmental impacts of the project, and that no additional geomorphology studies appear necessary.

County of San Luis Obispo. 2008. Mitigated Negative Declaration & Notice of Determination, Environmental Determination No. ED06-81. Re. Pankey Conditional Use Permit and Reclamation Plan DRC2005-00193. (April 3, 2008) (includes Initial Study checklist dated March 26, 2008)

The County issued a MND and attached Initial Study relying on the conclusions in SDC's October 5, 2007 report that the proposed Pankey instream mining project would have minimal or negligible impacts on fluvial geomorphology, bank stability, and riparian vegetation within the project site and off-site, including cumulative impacts, that would not otherwise be mitigated by the proposed monitoring plan.

California Department of Fish and Game. 2008. Re. Pankey Mine Conditional Use Permit, San Miguel, San Luis Obispo County, Mitigated Negative Declaration ED06-181, DRC2005-00193. Letter report from Bill Loudermilk, Regional Manager, to Jeff Oliveira and John Nall, County of San Luis Obispo. (May 7, 2008) 4 p.

CDFG found the proposed MND fails to completely address potential direct and cumulative impacts of the project and recommended an Environmental Impact Report (EIR) be prepared to address impacts of several new proposed instream mining projects on the Salinas and Estrella Rivers. Specifically, CDFG found the MND:

- Relies on unsupported assumptions underpinning the estimated sediment replenishment rate;
- Fails to adequately consider the potential for cumulative impacts to result from multiple active and proposed instream mines in the watershed;
- Does not refer to a monitoring plan; and
- Identifies general anticipated impacts to riverine resources but does not completely characterize the impacts so that the likely effectiveness of the proposed mitigation measures (i.e., setbacks) can be evaluated.

Referring to the need for an effective monitoring plan, CDFG expressed a desire to “work with the applicant and the County to develop a process and thresholds for ensuring that the operation is conducted in a sustainable manner.”

California Regional Water Quality Control Board. 2008. Re. Viborg/Calkins Mitigated Negative Declaration, Conditional Use Permit ED07-082. Letter from Roger Briggs, Executive Officer to Jeff Oliveira, Environmental Resource Specialist, San Luis Obispo County. (June 5, 2008) 4 p.

RWQCB found the proposed MND failed to consider cumulative impacts of sediment extraction from multiple active and proposed instream mines within the Salinas River system.

California Regional Water Quality Control Board. 2008. Re. Instream Mining. Letter from Roger Briggs, Executive Officer to Jeff Oliveira, Environmental Resource Specialist, San Luis Obispo County. (June 10, 2008) 1 p.

RWQCB clarified that comments made in its June 5, 2008 letter apply to all of the individually proposed instream mines in the Salinas River system, and citing the lack of an overarching watershed-scale geomorphology study, encouraged the County to prepare an EIR addressing watershed-scale cumulative impacts of instream mining.

Balance Hydrologics, Inc. 2008. Cumulative Impacts Appendix to Weyrick Peer Review Letter: Focus on Sediment Continuity in Relation to Existing and Proposed Mining Operations. Letter report to Mr. Jeff Oliveira, San Luis Obispo County. (July 16, 2008) 5 p. plus 3 tables.

In conducting peer review of the separate proposed Weyrick mine upstream from the Pankey mine site, Balance prepared a new estimate of bedload sediment load using stream gage data for the USGS’ Paso Robles gage high and low envelope regional sediment transport curves. Balance compared the resulting average annual bedload sediment replenishment rate and various exceedence or return interval (e.g., 1-year, 2-year) replenishment rates to the total permitted maximum (and 75% and 50% of total permitted maximum) extraction from known active and proposed mines in subreaches of the Salinas River within reasonable distance from the Weyrick mine site. Balance found that the estimated total annual extraction rates from the subreaches would exceed estimated annual natural replenishment rate in about 80 percent of years. In about 20 percent of years the replenishment rate would greatly exceed the maximum permitted extraction rate. Balance identified numerous simplifying assumptions that were required to formulate this preliminary cumulative impacts analysis to account for uncertainties in:

- Actual dynamics affecting sediment transport continuity between individual subreaches of the river especially given the episodic nature of sediment movement and large interannual variations in the same;
- Actual (proprietary) sediment extraction rates from active and proposed mines and differential interannual variations in extraction rates at multiple sites;
- Activity and permitting status of multiple active and proposed mines in the system confounding cumulative impacts analysis; and
- Technical rationale for extrapolating unit sediment yield values from one watershed location to others given watershed-specific sediment transport data are generally few for a watershed of this size.

California Department of Fish and Game. 2008. Re. Pankey Mine Conditional Use Permit. Letter report from Kit Custis, Senior Engineering Geologist, to Bill Loudermilk, Regional Manager. (September 18, 2008) 17 p.

CDFG prepared detailed comments to the SDC geomorphology reports recommending:

- Corrected application of the regional regression equations of Waananen and Crippen (1977) for estimating return interval flood discharges at the site;
- Mapping the 50- and 100-year FEMA floodplains on air photo site maps and mitigation measures for any project operations areas situated within the regulatory floodplain;
- Clarifying what the actual Salinas River drainage area is at the Pankey site (it changed from 1,245 sq mi in earlier reports to 1,515 sq mi in later reports without explanation);
- Explaining large differences between upper watershed unit sediment yields estimated by Watson et al. (2003) compared to Glysson (1977) and Knott (1976);
- Using density conversion factor of approx. 1.5 tons/CY rather than 1.0 tons/CY for sand and gravel extracted from the site;
- Considering the possible effect of sediment trapping within Santa Margarita Reservoir on the estimated sediment replenishment rate at the site;
- Evaluating potential cumulative impacts of multiple active and proposed instream mines in the Salinas River system;
- Considering the potential groundwater impacts if seasonal high groundwater elevation (e.g., following a very wet winter) exceeds the minimum bottom elevation of the proposed mining excavation area (i.e., redline depth);
- Preparing a site-specific design to provide improved conveyance through a partially sediment filled culvert running beneath the Vineyard Canyon Road that includes appropriate erosion control measures;
- Revising the Vineyard Creek excavation area as necessary to prevent destabilizing the steep eroded bank near Vineyard Canyon Road;
- Presenting the proposed excavation plan information including excavation area limits and pre-mining topographic contours on an air photo map base to improve interpretation of the mining plan and adequacy of the proposed setbacks in a geomorphic context;
- Preparing a plan containing site-specific mitigation measures for the downstream section of Vineyard Creek to prevent deleterious channel degradation potentially resulting from the proposed up to 5 ft deep excavation of the Salinas River bed (base level lowering);
- Detailing the proposed monitoring plan to specify
 - the surveying method, accuracy standards, horizontal and vertical datum, criteria for selecting cross-section locations, if and how annual air photos may be used to augment and improve the monitoring plan, etc.;
 - the surveying method for marking annual maximum excavation depth (e.g., referenced to a permanent elevation benchmark near but outside of the excavation area) for accurately guiding equipment operators to prevent overexcavation;
- Providing additional information about existing groundwater table dynamics in the direct vicinity of the proposed excavation area;
- Preparing a more comprehensive study of the project's potential cumulative impacts when the project's individual effects are considered in addition to the effects of multiple active and proposed instream mines within the Salinas River system, including but not limited to:

- comparing the revised natural sediment replenishment rate to the total maximum allowable extraction at all of the active and proposed instream mines in the system;
 - including the above recommended revisions and justifications applied to the estimated sediment replenishment rate;
 - considering the potential for impacts to existing structures (e.g., bridges, banks, pipelines) caused by potential cumulative channel bed degradation;
- Justifying direct drainage ratio extrapolation of upper watershed unit sediment yields from the literature to downstream locations because in some watersheds sediment yield decreases with increasing drainage area;
- Preparing an “area-wide sand and gravel extraction management plan” from which conditions of use could be applied to each new mine which “reflect and implement the area-wide adaptive management approach” (i.e., same as the comprehensive cumulative impacts study recommended above); and
- Obtaining written approval and/or specific Conditions of Approval of the excavation plan for Vineyard Creek from the County Department of Public Works.

CDFG’s detailed comments also acknowledged there are many uncertainties in estimating the sediment replenishment rate and anticipating cumulative impacts of multiple instream mines, and stressed the need for “the only alternative” – an effective monitoring program for adaptively managing against project impacts. CDFG outlined recommendations and guidelines for developing an acceptable monitoring program, including:

- Field marking and monitoring the depth of excavation to prevent equipment operators from overexcavating compared to both the annual maximum excavation depths and the project maximum redline depth;
- Measuring the depth to groundwater beneath the excavation area to prevent excavating below the vertical setback from the groundwater table;
- Measuring “stress in riparian vegetation”;
- Field marking and monitoring 20-ft setbacks from river banks;
- Measuring and documenting bank erosion;
- Measuring channel bed elevations changes with periodic cross-section and longitudinal profile surveys, including upstream and downstream from the excavation area;
- Using periodic air photos to document changes in channel form with, upstream, and downstream from the project site;

CDFG’s comments raised several important questions highlighting the complexity and necessary level of detail in developing the necessary adaptive management type monitoring program, including aspects of assigning responsibilities, triggers for noticing agencies, and the structure of the decision making process for identifying impacts and implementing mitigation measures, compliance, etc.

CDFG’s comments also focused on avoiding, minimizing, and mitigating effects of any project operations facilities and stockpiles planned for within the 100-year floodplain, including how potential site flooding would be predicted using rainfall forecast or other early warning information, and what site protection measures would be taken when a 100-year flood appeared possible.

CDFG commented that in addition to the required Storm Water Pollution Prevention Plan (SWPPP), the mine operator should also prepare a spill prevention and mitigation plan that provides noticing requirements and specific actions that will take place in the event of a spill.

Sierra Delta Corporation (SDC). 2008. Re. Pankey Mine Conditional Use Permit. Letter Report to John Nall, San Luis Obispo County. (October 8, 2008) 23 pp.

SDC prepared a letter report responding to most of the major topics in CDFG's September 18, 2008 comment letter. First, SDC clarified:

- 1,515 sq mi is the correct Salinas River drainage area for the Pankey site;
- The relatively low unit sediment yields of Watson et al. (2003) resulted from measurements made during a limited time period, and as such are less reliable than the long-term estimates (e.g., Glysson 1977) that SDC used to estimate the sediment replenishment rate at the site; and
- SDC measured in situ density of bulk sampled bed material from the project site finding it to be approx. 1.3 tons/CY.

SDC also:

- Corrected return interval flood discharge estimates according to regional regression equations of Waananen and Crippen (1977);
- Mapped the 100-year FEMA floodplain boundaries on an air photo of the site showing that the entire northern operations area is within the (roughly coinciding) 50-year and 100-year floodplains of the Salinas River. SDC noted that locating the operations areas outside of the floodplains would require disturbance of prime agricultural soils;
- Recommended a list of flood hazard mitigation measures for the operations area located in the Salinas River floodplain:
 - All equipment and supplies would be portable so they can be removed within 24 hours of identifying potentially hazardous flood conditions such as broadcast flood warnings from the National Weather Service;
 - All equipment and supplies would be removed if the operations area is to be inactive for more than 30 days between October and June;
 - The amount of sand and gravel stockpiled at the operation area would be limited during the winter months;
- Summarized generalized groundwater well observations from the four existing wells on the Pankey site, indicating that the typical seasonal high (Spring) groundwater table elevations were at about the same elevation as the adjacent Salinas River bed;
- Explained that the mining operation on Vineyard Creek would require only temporary equipment use and staging and none in the winter months, minimizing the need for flood hazard mitigation measures for operations within the 100-year floodplain of Vineyard Creek commensurate with that of the proposed operations area within the 50-year and 100-year Salinas River floodplains;
- Proposed 1-ft setback from the Vineyard Creek Canyon Road culvert and a 5-ft setback from the base of hills on either side of the excavation area. SDC proposed that rip-rap or other erosion control is the County's responsibility not the applicant's;
- Proposed 30-ft setback from the 16-ft-high near-vertical eroded bank that is within 22 horizontal feet from Vineyard Creek Canyon Road;
- Proposed using publically available annual USDA digital air photo imagery for project monitoring, and ground surveying elevation contour maps of the excavation area for planning and estimating annual excavation, except in years following dry winters when replenishment was minimal or mining is otherwise determined to be uneconomical; and

- Proposed special excavation of the Vineyard Creek-Salinas River confluence area to grade the Vineyard Creek channel at 3% slope over the downstream most 400 ft of channel.

SDC disagreed with:

- CDFG's recommended application of Strand and Pemberton (1987) and Morris and Fan (1997) generalized regression data for adjusting upper watershed unit sediment yields to downstream watershed locations. SDC found the scant Salinas River suspended sediment load data from Watson et al. (2003) were also inadequate for extrapolating unit sediment yields to the Site. Instead, SDC recommended assuming 25% and 50% unit sediment yield reductions in preparing a revised sediment replenishment rate estimate; and
- CDFG's listing and summation of maximum permitted extraction rates from multiple active and proposed instream mining sites in the Salinas River system. SDC submitted a new listing of maximum permitted extraction rates totaling 567,500 CY/yr permitted and proposed. SDC recommended assuming 25% and 50% reductions in total estimated extraction rate to account for years when mine operators do not or would not be able to extract the full permitted maximum.

SDC had by this time been provided a July 16, 2008 letter report from Balance to the County describing a preliminary basis for cumulative impacts analysis. It was part of the permitting process for the proposed Weyrick instream mine operation on the Salinas River upstream from the Pankey site. SDC discussed the relative merits of the Balance data compared to unit sediment yield data it previously used (e.g., Glysson 1977), finding the Balance "model...appears to be the most representative model for the reach to date." SDC recommends using the Balance data for estimating sediment replenishment rate at the Pankey site. SDC used the 25% and 50% unit sediment yield reductions (assumed for drainage area extrapolation) and the 25% and 50% reductions in permitted maximum extraction rate (accounting for assumed actual mine operations) to publish a matrix of sediment budgets for the Salinas River system. According to SDC's new system-wide estimates, the multiple active and proposed mines would, on an annual average basis, extract between 17% and 64% of the estimated replenishment rate. The supply-demand scenario comprised of 50% unit sediment yield reduction and 25% total permitted extraction rate reduction would allow approx. 52% to 61% of bedload sediment supply to pass through the Site. These were annual average estimates.

3. HISTORICAL GEOMORPHIC ANALYSIS OF THE PANKEY SITE

3.1 Introduction

Historical geomorphic analysis (e.g., Kondolf and Larson 1995) uses expert interpretation of sequential historical air photos and topographic and spot elevation data to characterize historical changes in river channel and floodplain form and attribute the changes to dominant geomorphic processes and trends. Changes in channel form and dimensions and evidence of floodplain surface and vegetation disturbance can be related to the chronology of floods occurring between air photo years to form expectations about what channel changes may be caused by future floods and droughts.

Alluvial streams draining California's Mediterranean climate watersheds exhibit dramatic changes in channel form and widespread erosion of channel banks and riparian vegetation resulting from individual large floods. It is commonly said that large floods "reset" the channel form. During the intervening decades numerous smaller floods produce none or shallow, less damaging floodplain flows and correspondingly little low-flow channel change. Left undisturbed, riparian vegetation slowly reestablishes its pre-flood density on floodplains and bars and 'encroaches' onto the low-flow channel bed. The low-flow channel progressively narrows to adjust to the series of smaller, shorter, shallower floods carrying less sediment. Year after year vegetation may encroach farther into the low-flow channel trapping sediment along the edges of the channel to reinforce the process of progressive channel narrowing. Then suddenly the cycle repeats – the channel resets.

Historical analysis also quantifies as far as feasible changes over time in channel bed elevation by collecting new channel bed elevation data for comparison to available historical data. Sources of historical elevation data include USGS quadrangle and other maps, topographic and as-built surveys for past projects, cross-section and long-profile surveys made by past studies or for FEMA flood insurance studies and floodplain map revisions, bridge maintenance records, and stream gage stage-discharge calibration. The amount and reliability of bed elevation data vary from site to site and from watershed to watershed. Corroboration should be sought between trends suggested by sometimes scant elevation data and sequential air photo interpretation in the vicinity of the elevation data.

When the available historical bed elevation data are plotted on a longitudinal profile view of the subject river reach, even a few data points often reveal trends or help to substantiate field-observed channel bed elevation trends. Sequences of data-rich historical longitudinal bed elevation profiles often clearly demonstrate natural patterns of fluctuating bed elevations – responses to large floods and intervening drought intervals, land use changes, or heavy sediment runoff following wildfires. Observed trends are also often attributed to changes in the frequency of floods and amounts of sediment delivery caused by urbanization and water supply development.

Even where historical bed elevation data are not available, presence/absence of significant bed elevation changes can sometimes be inferred by expert interpretation of air photo sequences. For example, an early air photo may show that a particular floodplain surface or bar unit had been recently disturbed by a moderate flood. It can be presumed that the surface sustained relatively deep flood flows. If a later air photo shows that the same surface had not been overtopped by a similar magnitude or larger flood, then it may be

presumed that the low-flow channel had incised (degraded, downcut) enough in the period between the air photos to have reduced overbank flows onto the subject floodplain surface.

3.2 Summary of historical geomorphic analysis completed to date

SDC (2007) conducted an historical geomorphic analysis of the Salinas River and Vineyard Creek within the Site. SDC prepared a narrative description of the channel and floodplain changes shown in a sequence of air photos from 1937, 1949, 1969, 1987, 1994, and 2002. SDC related these changes to a chronology of annual maximum peak flows measured at the Salinas River at Paso Robles gage (USGS #11147500). SDC observed that the Salinas River low-flow channel alignment changed dramatically as a result of the 1969 flood, and then did not change appreciably after the flood. SDC also suggested the air photo sequence indicated a long-term trend of increased floodplain activity, probably resulting from long-term channel bed aggradation. SDC (2007:20) reported there was corresponding field observational evidence of channel aggradation throughout the reach.

SDC also compiled and reviewed stage-discharge data for nearby stream gages and reviewed changes in bridge maintenance cross-section survey data to evaluate historical trends in channel bed elevations near the project site. SDC found the data indicated conflicting aggradation/degradation trends at the gage and bridge sites and did not support or refute their hypothesized aggradation trend.

3.3 Updated historical geomorphic analysis

geomorph reviewed the historical information compiled by SDC (2007) and other available information and prepared the following updated historical geomorphic analysis of the upper Salinas River in the vicinity of the Site.

Sequential historical air photo interpretation

Appendix A to SDC (2007) reproduces a sequence of same-scale air photos from 1937, 1949, 1969, 1987, 1994, and 2002 which are very useful for interpreting changes and trends in the low-flow channel form and frequency of floodplain disturbance at the Site. **geomorph** recommends that the reader print each of the 1"=1,000' scaled maps from the original digital .pdf version of Appendix A on separate 11"x17" sheets so that they can be laid out in chronological series for ease of comparison between photo years. These are therefore reproduced as Appendix B to this Plan. Also note that there are additional air photo data for the Salinas River downstream from the Site at pp. 2-12 in SDC (2007), showing conditions between the site boundary and the vicinity of Big Sandy Creek confluence about one mile downstream. Accordingly, the study reach for this historical analysis extends from the San Miguel Bridge upstream from the Site to the Big Sandy Creek confluence downstream from the Site (approx. 18,500-ft-long study reach).

SDC (2007) provided good resolution general topographic and spot bed elevation data covering the Salinas River extending from the San Miguel Bridge upstream from the Site to the downstream property boundary, dated 10-19-2005. No comparable bed elevation data are available downstream from the Site. This Plan divides the approx. 18,500-ft-long study reach into four sections (Figure 2):

- Upstream from the south excavation area;
- South excavation area;
- North excavation area; and

- Downstream from north excavation area (no bed elevation data available).

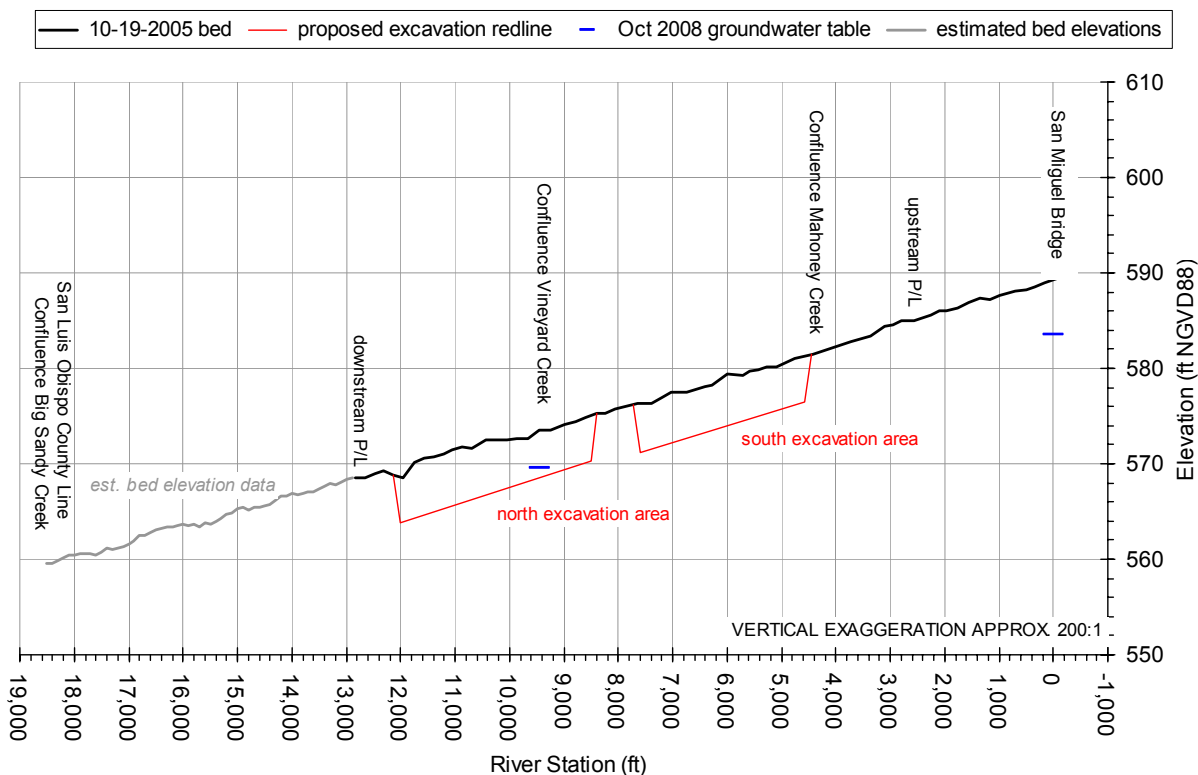


Figure 2. Longitudinal channel bed elevation profile of the **Salinas River** in the vicinity of the Pankey Sand and Gravel Mine Site (Source: 2- & 5-ft contour interval spot elevations from 10-19-2005 air photo). There are no comparable bed elevation data current available downstream from the site. The exaction redlines shown depict proposed 5-ft maximum project excavation depth and 25H:1V head and toe slopes. *Note there is 200:1 vertical exaggeration.*

SDC (2007) also prepared sequential air photo data and high resolution 10-19-2005 topographic and spot bed elevation data covering Vineyard Creek from its outlet at the Salinas River low-flow channel to a location approx. 8,300 ft upstream (Figure 3). The available detailed Vineyard Creek longitudinal profile data extend approx. 5,700 ft upstream from the proposed Vineyard Creek excavation area (Figure 3, Figure 4).

Reach-Scale Historical Geomorphology. Near the Site the upper Salinas River historically and presently is a single-thread meandering stream with transitional and multi-channel braided stream sections (Figure 5). The meandering activity of the stream forms a sinuous, variably wide meander belt confined between more massive and more erosion resistant older alluvium and unconsolidated sedimentary Paso Robles Formation that comprise the dominant valley fill. The active meander belt narrows and widens within the study reach from as little as approx. 800-ft-wide to as much as 1,700-ft-wide. In general, the stream is single-thread meandering with alternate and point bars where the meander belt is narrow and braided with mid-channel island bars where the meander belt is wide. All of the bars forming the meander belt are 'active', having last shown major deformation resulting from the 1969 flood. Field and air photo evidence suggest that the 1969 flood water surface overtopped the highest bar surfaces by as much as several feet.

Accordingly, although relatively infrequently overtopped, the bars are not fine-grained vertically accreting floodplains; they are sandy bars that are deeply overtopped and significantly deformed by moderate and large floods. Significant deformation by scour and deposition occurs on the bar surfaces during large floods, sometimes causing changes in the low-flow channel planform alignment. For example, the low-flow channel switched from one side of the meander belt to the other side when flood scour channels on alternate and point bars incised deeply enough during the 1969 flood to then convey the majority of the flow and the former low-flow channels were entirely filled with sediment – a natural geomorphic process termed ‘chute-cutoff’ (past alignment shown in Figure 5). This way the low-flow channel alignment was seen to switch between dominant reach-scale planform ‘modes’ which are fixed by the meander wavelength and fixed low-flow channel positions where the meander belt impinges on bedrock valley boundaries along the east side of the down-dropping valley. That the fixed positions are consistently impinged against the east side of the valley appears to result from a tectonic influenced down-to-the-east tendency near the study reach. There appear to be only two planform modes within the study reach which are partially fixed by the bedrock valley wall contact downstream from the Big Sandy Creek confluence. Chute-cutoff in the single-thread channel sections and both chute-cutoff and multiple bar dissection occur in the multi-channel braided channel sections.

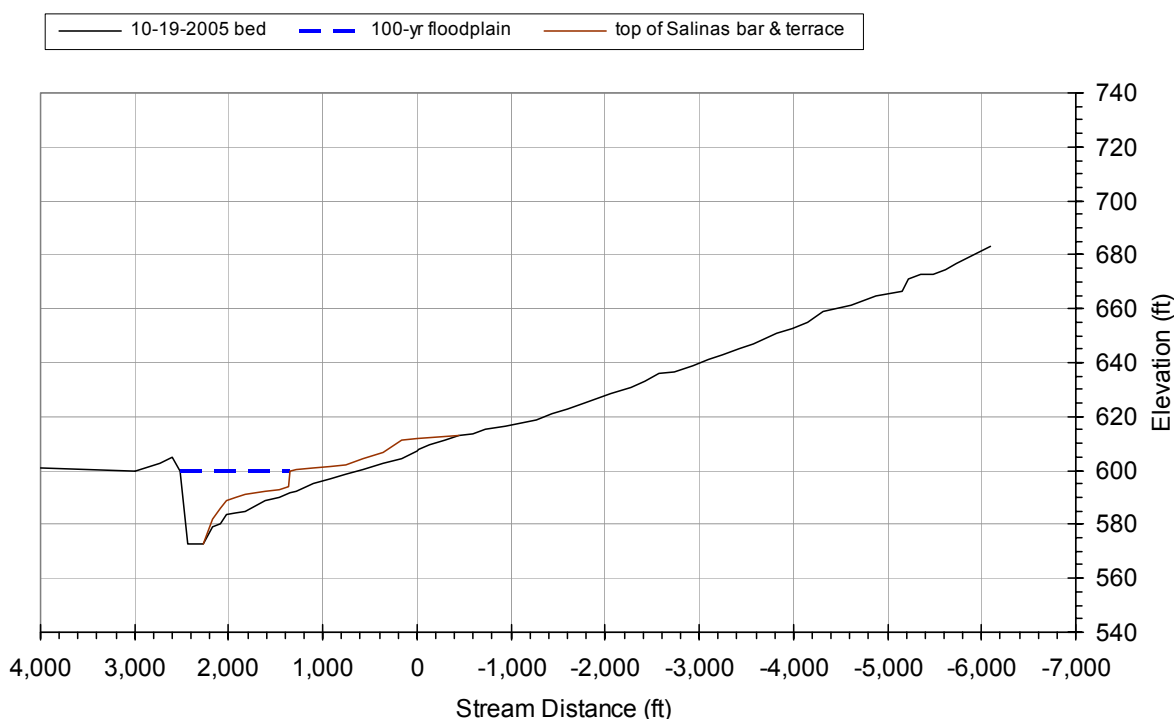


Figure 3. Longitudinal channel bed elevation profile of **Vineyard Creek** tributary to the Salinas River in the vicinity of the Pankey Sand and Gravel Mine Site (Source: 2- & 5-ft contour interval spot elevations from 10-19-2005 air photo). The Indian Valley Road Bridge crosses Vineyard Creek at stream distance 0 ft. The Salinas River 100-yr floodplain elevation is about 600 ft near the Vineyard Ck confluence, as estimated from reproductions of the FEMA floodplain map panels in SDC (2008).

The older alluvium forming the terrace banks along both edges of the active meander belt is of the older alluvium and in places the older Paso Robles Formation. It is unconsolidated but considerably more massive and erosion resistant than the geologically very recent,

poorly consolidated material forming the active floodplain bars. The 1969 flood eroded the modern alluvial banks hundreds of feet in places. The comparatively denser, higher terrace banks eroded only several horizontal feet in places, particularly at outside channel bends where the low-flow channel most directly impinges on them. Over the long term, lateral channel migration has substantially eroded the terrace banks and widened the meander belt in places. Along the right (east) bank along the upstream end of the Site the near-vertical terrace banks (Paso Robles Formation) presently stand approx. 45-ft-high above the active floodplain bar surfaces. The present low-flow channel impinges on the resulting point of terrace material at the downstream end of the widened reach (Figure 5). The low-flow channel also impinges on older alluvium for about 2,400 ft along the left (west) bank in the north excavation area opposite the Vineyard Creek confluence. About half of the riparian trees rooted on that steeply sloped approx. 25-ft-high terrace bank eroded into the river during the 1969 flood; about half of the riparian trees presently rooted on that bank date from before the 1969 flood.

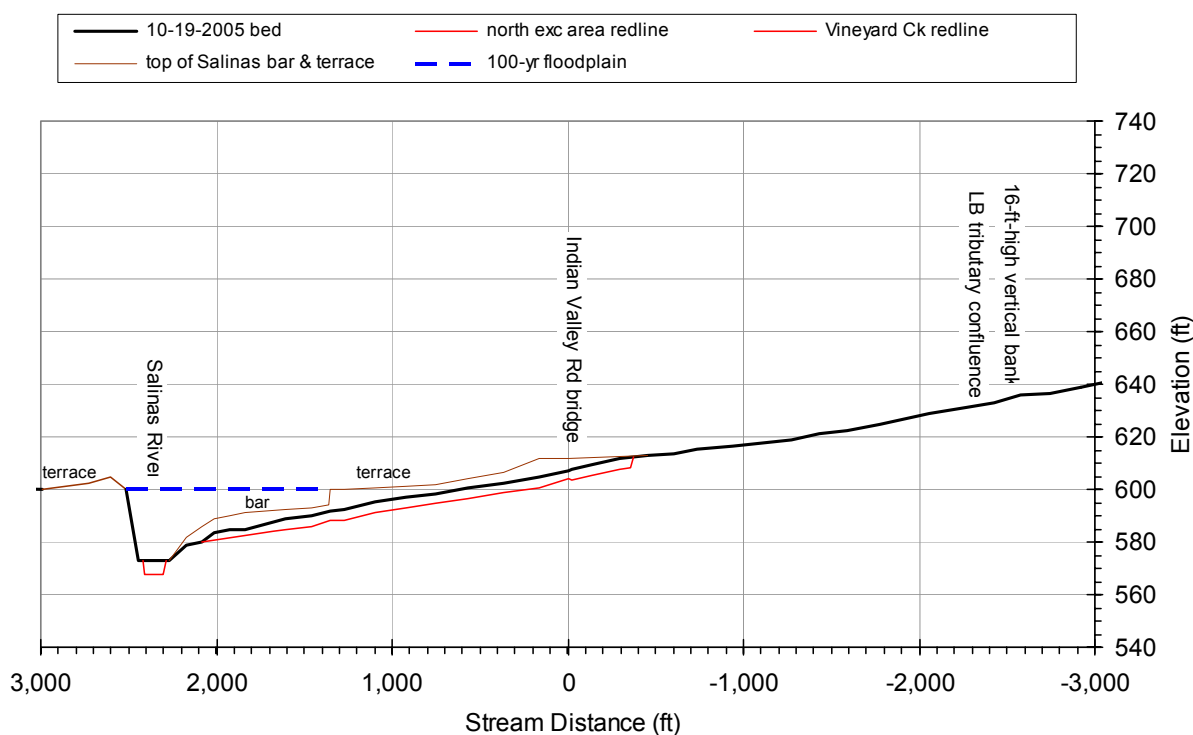


Figure 4. Longitudinal channel bed elevation profile of **Vineyard Creek** tributary to the Salinas River in the vicinity of the Pankey Sand and Gravel Mine Site (Source: 2- & 5-ft contour interval spot elevations from 10-19-2005 air photo). The minimum channel bed excavation profile (redline) (red) extends approx. 400 ft upstream from the Indian Valley Road Bridge to improve flood conveyance capacity beneath the bridge. The Salinas River 100-yr floodplain elevation is approximated from reproductions of the FEMA floodplain map panels in SDC (2008).

Presently, the active bar surfaces in the study reach lie approx. 11-14 ft below the older alluvial surfaces (terraces) lying along both edges of the valley (older alluvium and Paso Robles Formation). The planform of the recently active (Holocene) meander belt appears similar to that of its ancestral (Pleistocene) Salinas River but in places Holocene lateral channel migration appears to have significantly widened the meander belt by eroding the older alluvium. Most of this terrace bank erosion was accomplished during periods when the migrating low-flow channel was impinged on the toes of the resulting terrace bluffs. In the

vicinity of the study reach, the present low-flow channel impinges on terrace banks along part of all of the outside channel bends. Where the older alluvium is absent, the meander belt and in places also the low-flow channel abuts consolidated sedimentary bedrock canyon walls revealed beneath the massive mantle of Paso Robles Formation weathered to sloping dissected foothills (e.g., downstream from Big Sandy Creek confluence).

This 'catastrophic' type mechanism of low-flow channel planform change differs from the 'classical' lateral migration mechanism of meandering streams whereby outside bends move downstream by incremental progressive bank erosion and inside bends move downstream by point bar accretion (a process sometimes termed bar or floodplain "scrolling"). The latter mechanism occurs in more temperate climates and in lower energy, less confined valley settings than the study reach (probably including pre-development and any still natural sections of the Lower Salinas River). Within the study reach, the stream power at low-flow channel bankfull discharge (approx. 20,000 cfs or 570 m³/s) is approx. 10,000 W/m, and the specific stream power is approx. 120 W/m². For large floods producing deep flow on the bars, such as the 1969 flood (approx. 80,000 cfs or 2,100 m³/s), stream power approaches approx. 40,000 W/m and the specific stream power may slightly exceed 120 W/m². Hence, according to the energy based floodplain classification of Nanson and Croke (1992), the study reach is medium-energy (10-300 W/m²) and typical of a "braided river" floodplain type (50-300 W/ m²) rather than a "lateral migration scrolled" floodplain type (10-60 m²).

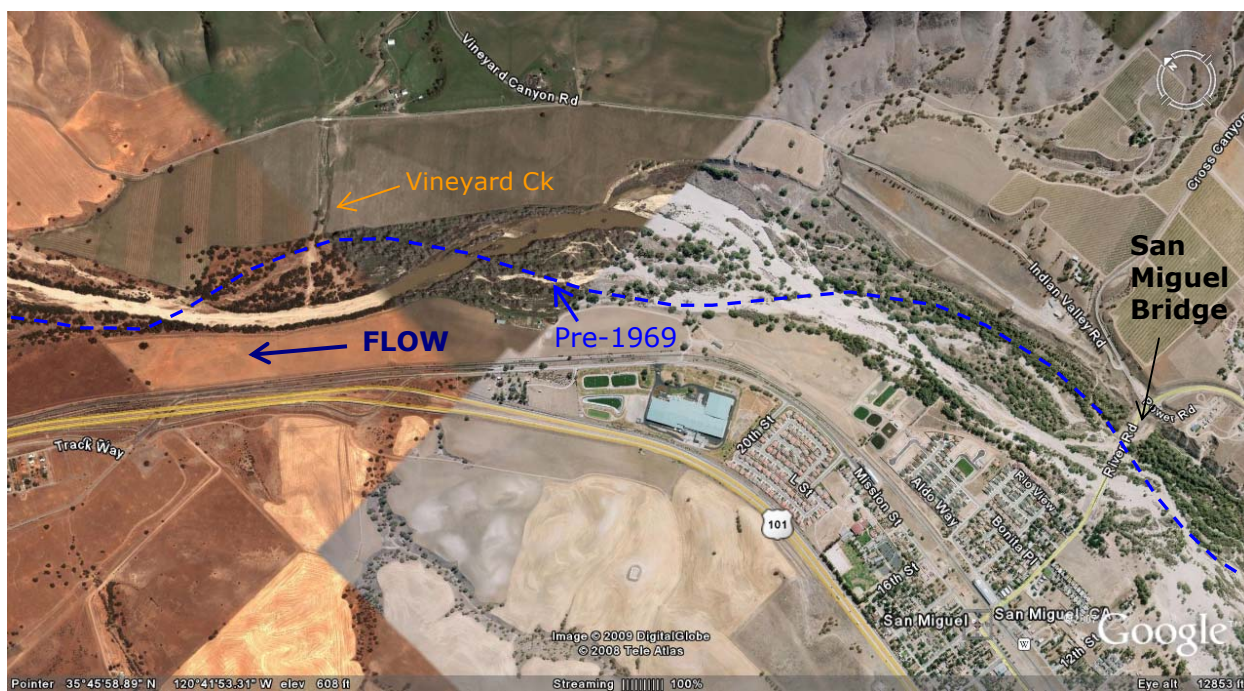


Figure 5. Recent air photo of the upper Salinas River in the vicinity of the Pankey Sand and Gravel Mine Site. (Source: Google). See Appendix C for additional site plan information including high resolution air photos, approx. property boundaries and proposed excavation area limits.

That more of the study reach does not exhibit strong multi-channel braided channel form appears due to confinement of the meander belt between more massive and more erosion resistant deposits (terraces) forming the dominant valley fill, and associated 'fixing' of low-flow channel outside bend positions impinged on incompletely eroded terrace walls and exposed bedrock foothills valley walls. Provided less confinement by these erosion resistant terraces, the study reach would probably be more completely and more strongly braided.

This way the study reach can be said to be transitional between single-thread meandering and multiple-channel braided channel forms. Leopold and Wolman (1957) distinguished braided and meandering streams based on the slope-discharge relationship (Figure 6); the study reach (bankfull discharge approx. 570 m³/s, slope approx. 0.0017) plots within the "braided" area.

Knighton (1998) noted that Leopold and Wolman's braided channel category included streams with a range of multiple-channel forms and some with only locally braided channel sections. The upper Salinas River with its locally-braided channel sections separated by transitional and strongly single-thread channel sections would have qualified as "braided" in Leopold and Wolman's classification system. Indeed, even where the upper Salinas River low-flow channel is strongly single-thread meandering, adjacent bar surfaces have strongly braided scour channel patterns, and the low-flow channel bed itself exhibits strong micro-scale channel braiding. According to Knighton (1998:207), "braided rivers consist of flow separated by bars within a defined channel which may be inundated at higher discharges which may give the appearance of a single channel close to bankfull."

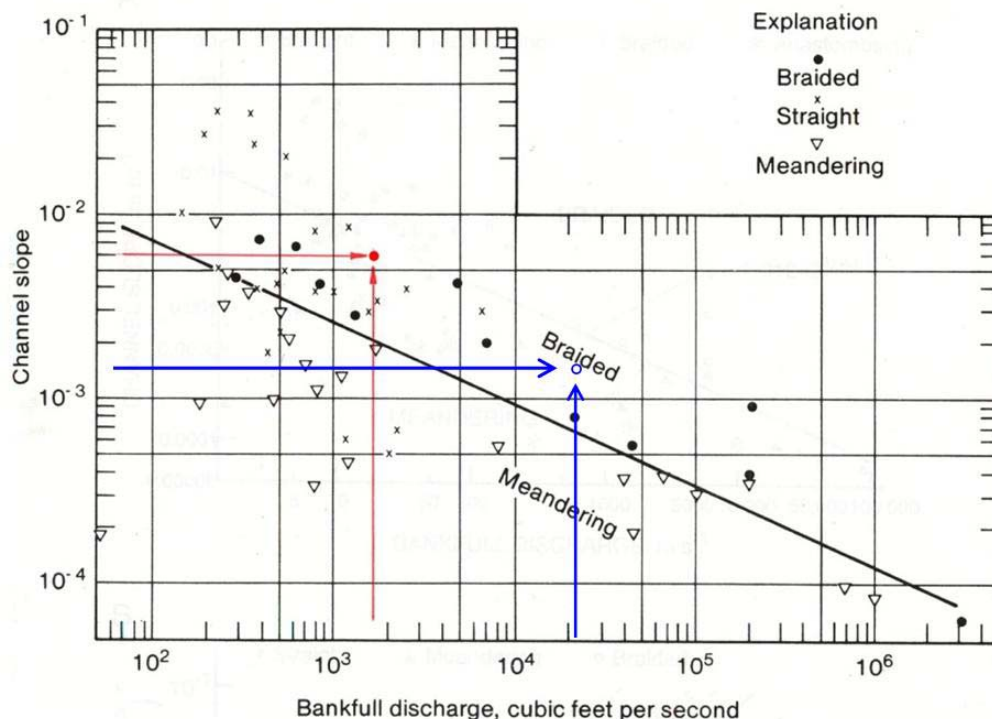


Figure 6. Plotting position of upper Salinas River at the Pankey Site (blue) on the braided-meandering stream classification of Leopold and Wolman (1957). Estimated bankfull discharge 23,000 cfs determined by Manning's calculation for representative cross-section at site. Slope 0.0017 determined from 2005 air photogrammetry spot elevations on low-flow channel centerline. Red plotting position is for Mill Creek near Covelo, CA – a coarse gravel and cobble-bedded channel with strongly braided and transitional channel sections.

Overall, the upper Salinas River appears historically and presently transitional between single-thread meandering and braided. Carson (1984) suggested that chute cutoff dissection of point bars indicates a transitional state between meandering and braiding. Church and Jones (1982) identified locally braided channel sections as 'sedimentation zones'

which alternate with single-thread or transitional 'transport zones', likening sedimentation zones to large-scale sediment stores resulting from ongoing downstream movement of large sediment deliveries by past events. Indeed, the strongly braided channel section within the study reach occurs where the meander belt has been overwidened by terrace bank erosion at the left bank (Figure 5). It appears that recurring massive sediment deposition in the braided channel section increased erosion pressure on the terrace banks, leading to a self-reinforcing cyclic process of sediment deposition and channel widening, supporting a braided channel form. How and why the self-reinforcing process began at this particular channel location may be related to differential erosion resistance of the terrace material and/or irregularity of the meander belt-terrace boundary superimposed by the ancestral upper Salinas River. Also a tendency toward massive sediment deposition may be expected at this location it being immediately downstream from the Estrella River tributary confluence. Indeed, the widest most braided sections of the upper Salinas River including within the study reach occur within 1.5 miles downstream from the Estrella River confluence. The 949-sq-mi Estrella River watershed more than doubles the drainage area of the upper Salinas River where it discharges to the Salinas about 1.25 miles upstream from the Site. Maximum flood peaks and sediment load peaks on the Salinas and Estrella are probably often out of phase, in some cases causing excessive sedimentation on the Salinas downstream from the confluence (e.g., as reported by Upper Salinas-Las Tablas RCD 2004).

Where Vineyard Creek enters the upper Salinas River meander belt it deposited an approx. 8-ft-high new alluvial fan on the Salinas River floodplain bar surface during the 1969 flood. Before the flood, the low-flow channel of the Salinas had impinged directly on the terrace bank at the Vineyard Creek confluence (Figure 5). The 1969 flood deposited the bar surface and the alluvial fan. The present bar surface is 11-14 ft below the top of the terrace bank and the fanhead apex lies approx. 6 ft below it. Salinas River flood flows impinge on the Vineyard Creek alluvial fan, such that the fan deposit is well developed and gradually sloped downstream from the fan apex, but the axial and upstream flanks of the fan were evacuated by the impinging 1969 flood flow. The maximum fanhead apex elevation (approx. 592.5 ft) suggests that the 1969 Vineyard Creek flood may have peaked when the Salinas River flood water surface elevation was approx. 594 ft and probably still rising. The Salinas River 100-year floodplain is entirely or almost entirely contained within the active meander belt; the 100-year flood produces flood flows several feet deep over the active floodplain bar surfaces (e.g., Figure 4).

Beneath the San Miguel Bridge upstream from the Site the upper Salinas River presently appears transitional between single-thread meandering and braided (Figure 5). The Salinas River is braided in the upstream half of the Site (south excavation area) beginning where the meander belt width increases dramatically. The river is strongly single-thread meandering in the downstream half of the Site (north excavation area) beginning where the meander belt is narrowest (approx. 800-ft-wide). The meander belt gradually widens downstream from the Site and the river again appears transitional in channel form. Near the Big Sandy Creek tributary confluence the channel form appears strongly influenced by the local tributary sediment deposits.

The low-flow channel width and depth vary along the study reach. Upstream from the Site the low-flow channel is about 8-ft-deep and as narrow as 150-ft-wide. The main flood scour channel is about 4-ft-deep and about 80-ft-wide. The low-flow channel averages about 350-400-ft wide in the braided section in the south excavation area, with 3-4-ft-high bars forming the inset braided low-flow channel complex. The complex is incised 8-10 ft into the higher bar surfaces. The higher bar surface is cut by a braided network of 6-ft-deep, 75-100-ft-wide scour channels. The strongly single-thread meandering section in the north excavation area has a relatively uniformly approx. 200-ft-wide, 9-11-ft deep low-flow

channel. Flood scour channels appear poorly developed on the adjacent bar surface. Downstream from the Site the low-flow channel shallows and widens, showing a braiding tendency; there are multiple floodplain surface elevations and complex networks of braided flood scour channels.

The Salinas River low-flow channel bed is sloped approx. 0.0016 ft/ft from just upstream from San Miguel Bridge to the downstream property boundary (Figure 2). The slope is greater in the braided reach (south excavation area) (0.0019) and lower in the single-thread meandering reach (north excavation area) (0.0015). Between spot elevations 200 ft apart the maximum local bed slopes approach 0.0040 on the downstream end of some of the mid-channel bars in the braided channel section.

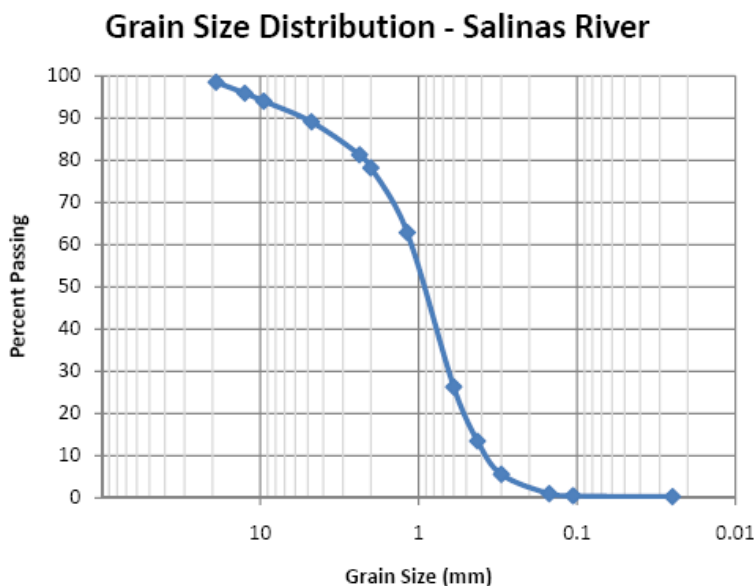


Figure 7. Measured grain size distribution from Salinas River bed bulk sample within the proposed north excavation area of the proposed Pankey Sand and Gravel Mine Site (Source: SDC 2007).

SDC (2007) measured the grain size distribution of a bulk sediment sample taken from the upper Salinas River bed in the proposed north excavation area (Figure 7). Approx. 22% of the bed sediment by weight was fine to medium gravel and approx. 78% of the bed sediment was sand (finer than 2 mm and coarser than 0.0625 mm). Virtually none of the bed material in the sample was silt or clay.

Watershed-Scale Sediment Transport. As defined recently by the Upper Salinas-Las Tablas RCD (2004), the approx. 2,000-sq-mile upper Salinas River watershed area includes the Nacimiento River watershed (Figure 8). By this definition, the upper Salinas River extends about 3.4 miles downstream from the San Luis Obispo-Monterey County line to the Nacimiento River tributary confluence (Figure 9). Highway 101 and the adjacent Southern Pacific Railroad (SPRR) bridge cross the Salinas about 0.5 miles upstream from the Nacimiento River confluence. Topographic maps and air photos show that the upper and lower Salinas Rivers are separated by a somewhat steeper and narrower geologic-tectonic controlled 'canyon' section. The regulated Nacimiento and San Antonio Rivers are tributary

to the 'canyon' section. In general watershed-scale sediment transport terms, the upper Salinas River and the canyon section are transport reaches and the Lower Salinas River transitions between transporting and depositional.

McGrath (1987) observed that the lower Salinas River gradient has markedly decreased as sea level has risen, such that the downstream most section of the river is now strongly depositional. Synoptic gage data shows that the 1969 flood peaked at 117,000 cfs at Soledad and only 83,000 cfs downstream at Spreckles; nearly half of the flood flow was out of the channel on the floodplain at Spreckles. PWA (2008:23) observed that the lower river begins to overflow onto the broad fine-grained depositional floodplain (primarily occupied by agricultural fields) at discharges exceeding approximately 20,000 cfs. Notably, the same volume discharge would be completely or nearly completely contained within the low-flow channel of the upper Salinas River at the Pankey Site. Combellick and Osborne (1977) studied sediment size on the lower Salinas River bed, finding that coarse sand-sized sediment (i.e., beach-sized sediment) is left on the bed or deposited on floodplains before reaching the river mouth (where it might otherwise contribute to needed beach nourishment). Willis and Griggs (2003) estimated that sand- and gravel-sized sediment flux at Spreckles to be approx. 490,000 CY/yr. It is generally thought to be much higher upstream from Spreckles, but reasonably reliable transport data are only available at Spreckles.



Figure 8. The approx. 2,000-sq-mi upper Salinas River watershed area designated by and adapted from Upper Salinas-Las Tablas RCD (2004). The total Salinas River watershed area is approx. 4,165 sq mi.

In 2000-2001, Watson et al. (2003) made suspended sediment concentration measurements at selected locations along the Salinas River and selected tributaries. According to Watson et al. (2003), these limited period sediment transport observations

suggested that: (1) Salinas River sediment yield is globally median-valued among watersheds of its size; (2) per unit area sediment yield increased in the upstream to downstream direction (counter to the typical relationship); and (3) east side tributaries with lesser annual average precipitation may have surprisingly large sediment runoff, as may be related to effects of the San Andreas Fault zone.

Watson et al. (2003) observed that many individual storm flows pour out into the upper Salinas River bed from tributary watersheds only to soak into its dry bed. It follows that extended periods of relatively low flooding would deposit sediment on the Salinas River bed downstream from tributaries; sediment that will some years later be transported downstream. Studies focused on the Lower Salinas River have focused on the heavy fine sediment load in the system. McGrath (1987) observed there is an over supply of fine sediment in the Salinas River system. PWA (2008:21) suggested that the over supply was due to the natural dryness of the eastern portion of the watershed, the expansion of intense agriculture, and frequent disturbance and erosion induced by stream channel modifications.

These general sediment transport and yield observations are reviewed in Section 4 as pertain to reliability for estimating unit area bedload sediment yield for the entire upper Salinas River watershed area.

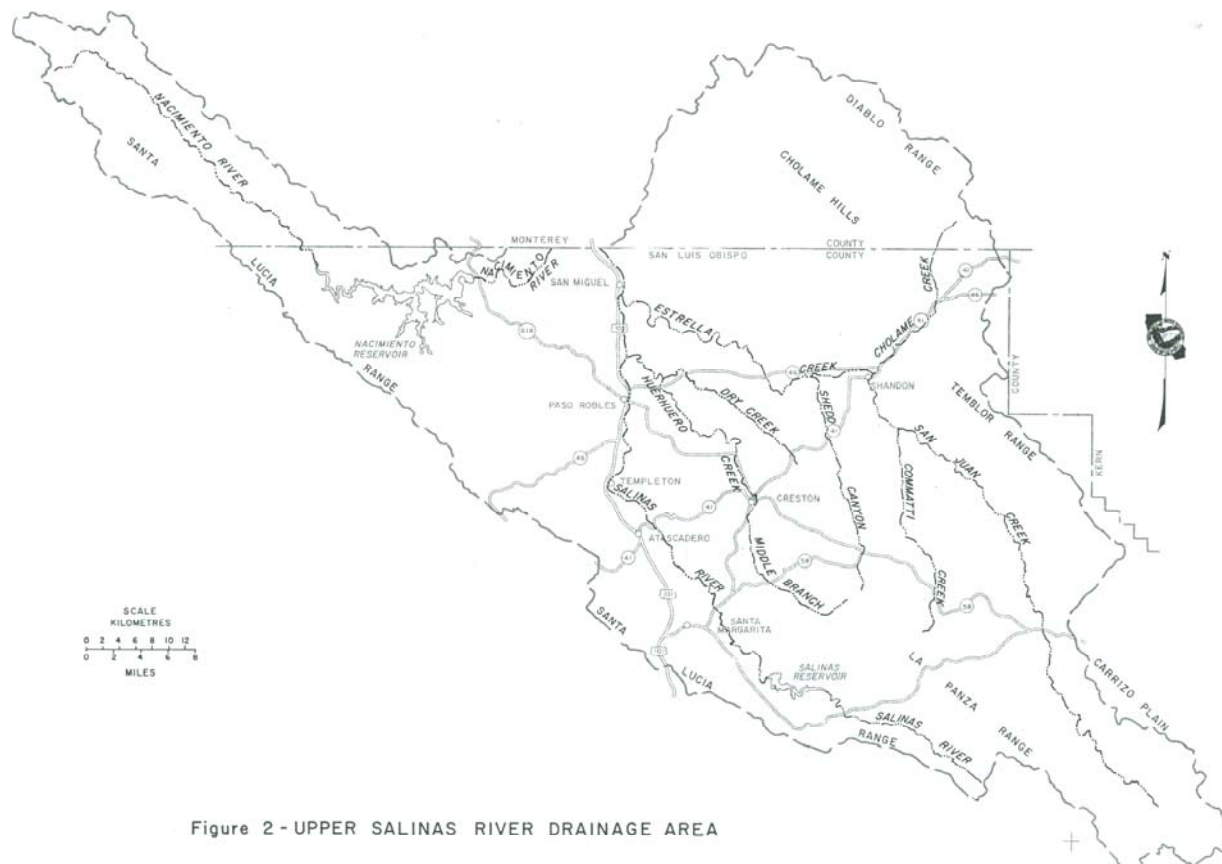


Figure 2 - UPPER SALINAS RIVER DRAINAGE AREA

Figure 9. The major streams comprising the approx. 2,000-sq-mi upper Salinas River watershed area designated by Upper Salinas-Las Tablas RCD (2004). (Figure adapted from DWR 1979).

1937 Air Photos. In the February 1937 air photos of the Site, the upper Salinas River low-flow channel was relatively wide and appeared perhaps more strongly braided than it is today. Please see Appendix B for a sequence of to-scale historical air photos of the Pankey Site reproduced from SDC (2007). Within the low-flow channel itself, the low-flow bedforms are also strongly braided, especially where the low-flow channel is wider; there appears to be active sediment transport and downstream migration of bars on the low-flow channel bed occurring at or near typical winter baseflow. Flood channels on the higher alternate and point bar surfaces were wide, sandy, and unvegetated, appearing to have been significantly scoured within the past several years. However, there are no gage records indicating there had been a moderate or large flood on the Salinas River during the late 1920s or early 1930s. The annual peak flow record for the Salinas River gage upstream from the site at Paso Robles does not contain pre-1937 data (Figure 10).

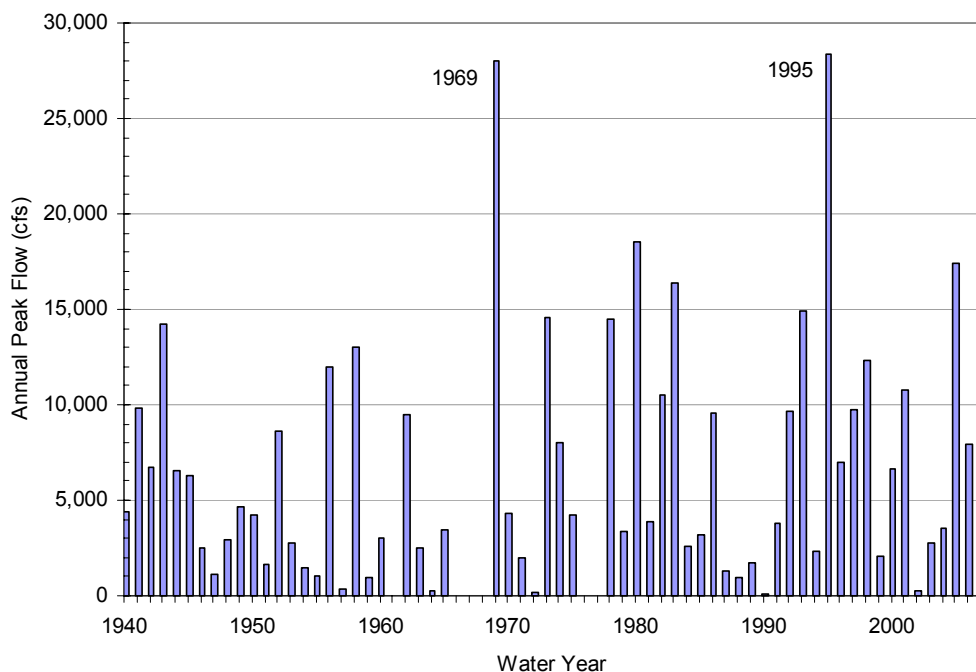


Figure 10. Annual Peak Flows Salinas River at Paso Robles (USGS 11147500), drainage area 390 sq. mi., 1940-2007 (Source: USGS).

Neither does the next downstream gage on the Salinas River just downstream from the Nacimiento River confluence near Bradley (Figure 11). There are three USGS stream gages with partial pre-1937 annual peak flow records: Salinas River near Santa Margarita CA (11145500); Arroyo Seco near Soledad CA (11152000); and Salinas River nr Spreckles CA (11152500). The Santa Margarita gage record begins in 1933 and includes no significant peak flows between 1933 and 1937 (notable drought period in California and elsewhere in western North America). The Arroyo Seco record is complete back to 1906 – it does not suggest there were any floods exceeding an approx. 10-year recurrence interval in the years leading up to 1937. The appearance of recent floodplain disturbance in the 1937 air photos may have been partly the result of extended drought limiting establishment, survival, and growth of riparian vegetation, especially on the flood scour channeled portion of the bar surfaces. Whether or not the riparian corridor may have been grazed by cattle has not been substantiated by this study.

In general, the largest floods of record on the Salinas River were in 1862, 1866, 1878, 1890, 1911, 1914, 1938, 1943, 1945, 1967, 1969, 1978, 1983, and 1995. The Spreckles gage on the Lower Salinas River includes peak flood stage data for the 1862, 1911, and 1914 floods. It lacks data between 1914 and 1930. Spreckles gage data for 1930-1937 do not include significant floods.

1925 and 1927 brought moderate and large floods to many southern Coastal California rivers (Santa Margarita River, Santa Ana River, etc.) However, there were only 5-year floods on the neighboring Santa Ynez River in 1927 and 1932. It therefore seems likely that there had been comparable, only moderate floods on the upper Salinas River in 1927 and 1932. Historical air photo sequences of the Santa Margarita River include 1929 and 1938 photos. The 1929 photos show the recent effects of a channel resetting flood (ca. 1927); the 1938 photos show no channel change and moderate reestablishment of riparian vegetation on bars. The 1937 photos of the upper Salinas River near the Site appear to show the same sequence of processes having occurred. The low-flow channel is relatively wide. Young riparian vegetation is established on about half of the low-flow channel banks areas. Low attached and mid-channel bars recently formed within the low-flow channel area lack riparian vegetation. Bare sand and strips of young vegetation dominate the bar surfaces within most of the meander belt. Mature riparian vegetation is practically limited to the terrace banks along the edges of the meander belt. Overall, the 1937 photos suggest the study reach had experienced several years of low floods following a moderately large flood, probably in 1927 and/or 1932. Again, the stream gage records lack specific data for reliably estimating the date, magnitude, and expected recurrence interval of the 1927 and 1932 flood(s).

1949 Air Photos. The April 3, 1949 air photos were made after a period of relatively low flooding and six years after the moderately large flood of 1943. The 1943 flood exceeded 14,000 cfs at the Paso Robles gage (Figure 10) – about a 7-year flood there. The air photos show that the low-flow channel narrowed somewhat between 1937 and 1949. Almost all of the bare low-flow channel banks and low-elevation in-channel bars shown in the 1937 photos were covered with dense riparian vegetation in 1949. Vegetation establishment on in-channel bars appears to have accelerated bar growth and low-flow channel narrowing. Wider low-flow channel sections with braided in-channel bars remained poorly vegetated indicating that the surfaces were probably frequently disturbed by numerous typical low floods of the period. Higher bar surfaces appeared undisturbed. The strips and remnant islands of young riparian vegetation shown on the bars in the 1937 photos have expanded by 1949, but there remained large portions of the bare sandy surfaces. There were by now several individual bar surfaces that are densely vegetated and will show erosion resistance during future floods. One explanation for the increased vegetation density between 1937 and 1949 may be cessation of livestock grazing within the riparian corridor sometime after the Dust Bowl drought or during WWII, but this study has not yet produced any data to substantiate the grazing history at the Site.

1969 Air Photos. The March 28, 1969 air photos were made soon after the spectacularly damaging and channel resetting flood of January 1969. The 1969 flood destroyed the San Miguel Bridge located about 0.5 miles upstream from the Site's upstream property boundary. The flood switched the meandering low-flow channel from one side of the meander belt to the other (e.g., Figure 5). Channel switching was accomplished not by lateral bank erosion through the entire width of the meander belt, but instead by severe downcutting of scour channels on the bar surfaces and bar deposition on and filling of the former low-flow channel. It appeared that more than at least one million CY of sand and gravel was evacuated from the Site by the flood in cutting the new low-flow channel. At a minimum, a comparable amount of sediment filled the former low-flow channel and

aggraded bars in places. The flood removed large islands of dense riparian vegetation and caused net aggradation of high bar surfaces. The flood overtopped the present bar surfaces by several vertical feet, producing deposits of sand and gravel several feet deep, particularly in areas where densely established riparian vegetation mentioned above prevented scour and induced bar aggradation. Overall, the flood removed more than approx. 80% of the riparian vegetation then present within the study reach. The flood removed as much as about 20% of the mature riparian vegetation rooted on terrace banks along the edges of the meander belt. The flood removed the majority of the mature riparian vegetation along the western edge of the corridor across from the Vineyard Creek confluence; it eroded 25-ft-high terrace banks there several horizontal feet over a length of several hundred feet.

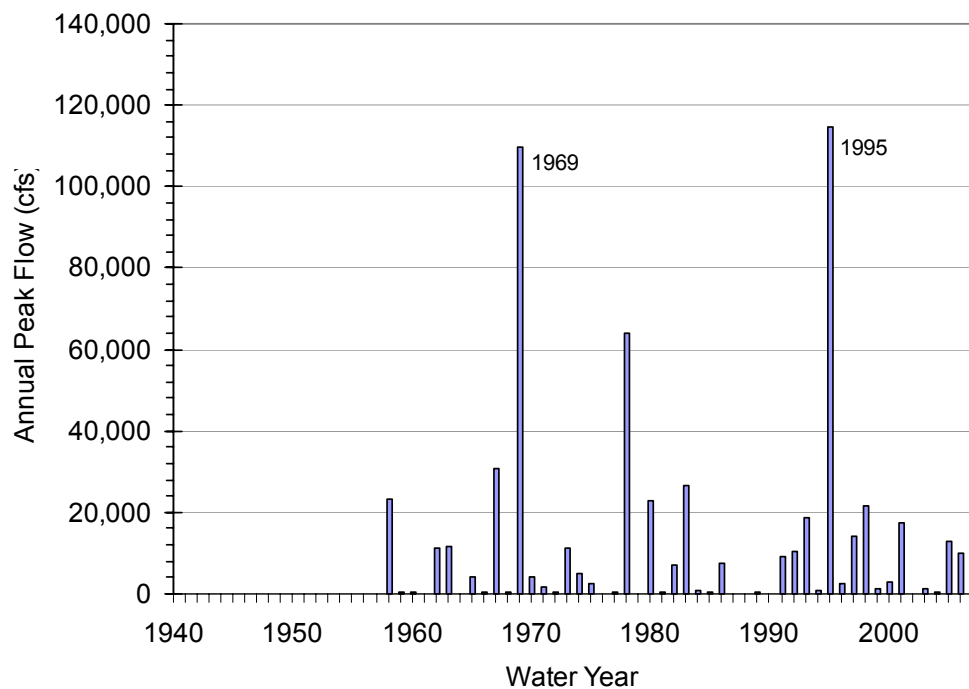


Figure 11. Roughly estimated Annual Peak Flows on the Salinas River upstream from Nacimiento River confluence and downstream from the Big Sandy Creek confluence. Produced by subtracting annual peak flows measured at Nacimiento River blw Nacimiento Dam nr Bradley (USGS 11149400) from annual peak flows measured at Salinas River nr Bradley (USGS 11150500), drainage areas 329 sq mi and 2,535 sq mi, respectively, 1958-2007 (Source: USGS).

As discussed above, switching of the low-flow channel from the east to the west side of the corridor in the vicinity of the Vineyard Creek confluence caused filling of the former low-flow channel up to the present floodplain bar elevation about 11-14 ft below the top of the terrace bank. Vineyard Creek sediment discharge produced an 8-ft high alluvial fan deposit on the floodplain bar surface. Upstream, the entire narrow Vineyard Creek floodplain was covered with new bare sediment. In some of the individual channel meanders wide enough to support mature riparian vegetation on point bars, as much as half of the mature riparian vegetation was toppled and transported downstream by the flood, probably coming to rest on the upstream face of the Indian Valley Road Bridge and contributing to its failure during the flood. Vineyard Creek straightened considerably in the vicinity of the ranch buildings upstream from Indian Valley Road Bridge and on the terrace surface downstream from the bridge; two chute cut-offs appear to have been partly induced by narrow pilot channels

excavated between 1937 and 1949, and reinforced by channel repair work following the flood.

Bankfull discharge estimate. Bankfull discharge is variously defined in the literature and professional practice. The basic definition is the amount of flow that fills the low-flow channel and begins to crest over onto active floodplain and/or high bar surfaces adjacent to the channel. Bankfull discharge is conceived of also as a threshold discharge above which the dominant geomorphic processes occur in the system. In alluvial rivers, geomorphic changes are forced by transport, sorting, and deposition of sediment delivered into the reach. Thus, a surrogate for bankfull discharge is “geomorphically effective” or dominant discharge. Dominant discharge is a threshold; cumulatively, all of the flows below the threshold deliver the majority of sediment into the reach. That is, low floods are very frequent but they each carry relatively little sediment. Large floods carry exponentially greater sediment loads, but they are infrequent. Both empirical data and analytical computations have shown that low and moderate floods, cumulatively, carry the majority of sediment and thereby exert the strongest continuous influence on channel form. In temperate climates, statistically, these most “effective” floods occur about once every 2 years. However, in semi-arid and arid climates the dominant discharge is exceeded less often. Wolman and Gerson (1978) estimated that 5-6-year floods were generally most effective in forcing the geomorphic processes as expressed in channel form changes and riparian vegetation dynamics. It is as if the intervening periods of lesser discharges have an insignificant effect on the channel form. Sequential air photo analysis tends to confirm this.

Indeed, we have seen that little happens on the study reach during periods of relatively low floods. We have seen that the wider sections of the upper Salinas River low-flow channel tend toward a braided channel form, and there is braiding on the low-flow channel bed surfaces as well. Attached and mid-channel bars form on the bed and continue to migrate downstream during the recession limb of relatively low flood flows and may be repeatedly deformed by low flood flows occurring several times each winter. In the absence of scouring floods, vegetation establishes on these low bar surfaces and temporarily arrests low bar migration. The low-flow channel progressively narrows as vegetation encroaches. We have also seen that large floods completely scour near-channel vegetation and significantly enlarge the low-flow channel. Large floods also produce deep flows on all floodplain bar surfaces within the meander belt with sufficient power to scour new large channels and deposit several ft-deep superimposed coarse-grained bars. Between 1937 and 1969, only the 1969 flood was large enough to deliver and move enough sediment to force changes in the channel form, size, and floodplain bar structure. It was so large that it virtually destroyed the previous system. We would expect that moderate magnitude floods would be sufficient to cause geomorphically or ecologically significant changes: sufficient to widen the low flow channel, scour a portion of the near-bank riparian vegetation, and deposit fresh bars for colonization by riparian vegetation; sufficient to remove some of the younger riparian vegetation on floodplain bar surfaces and deposit fresh irrigated sediment for colonization by riparian tree seedlings.

The present low-flow channel in the northern part of the Site (north excavation area) is about 225-ft-wide and 10-ft-deep. The slope is 0.0016 ft/ft. According to Manning’s equation, the average flow velocity should be about 10 ft/sec when the low-flow channel is flowing full and beginning to crest onto the high bar surfaces; the discharge would be about 23,000 cubic feet per second (cfs). Peak flows that approach or slightly exceed about 23,000 cfs should be expected to completely rework the low-flow channel bed forms and incrementally widen the low-flow channel by lateral bank erosion in places along the reach, removing a substantial portion of near-bank riparian vegetation. Shallow sand- and silt-laden overbank flows would not scour channels and remove floodplain vegetation, but would

deposit freshly irrigated sediment in places which may be colonized by wind or water borne riparian seedlings or by vegetative reproduction of expanding vegetation colonies. Much larger peak flows would be required to overtop the high bar surfaces deeply enough to substantially disturb and bury the existing vegetation. Peak flows approaching or exceeding approx. 38,000 cfs would be required to produce an estimated 3-ft-deep flow on the floodplain bar near the Vineyard Creek confluence under current conditions.

The nearest stream gages to the Site (total drainage area 1,617 sq mi or 1,668 sq mi if including poorly drained Carrizo Plains area) are the Paso Robles gage (390 sq mi) and the Bradley gage (2,535 sq mi) respectively about 11 miles upstream and downstream from the Site. The Paso Robles gage lies upstream from the Huerhuero Creek and Estrella River tributary confluences. The Bradley gage includes discharges from these tributaries as well as the Big Sandy Creek and regulated Nacimiento River watersheds discharging to the Salinas downstream from the site. Figure 11 shows roughly estimated annual peak flows on the Salinas River downstream from the Big Sandy Creek confluence which can be taken as a best available surrogate for actual peak flows sustained at the Pankey site. First, it should be noted that the floods of 1969 and 1995 far exceeded any other floods of record. Other than these two very large floods, only the 1978 flood produced a peak flow near the Site exceeding 38,000 cfs. Exceeding approx. 60,000 cfs, the 1978 flood would have inundated the entire meander belt width and overtopped the present high bar surfaces by more than 5-6 ft. Other than these three large floods, only the 1927, 1943, 1958, 1967, and 1983 floods produced enough discharge to completely inundate the meander belt width and produce shallow flows on the highest bar surfaces at the Site.

1987 Air Photos. The August 21, 1987 air photos were made 18 years after the 1969 flood and nine years after the 1978 flood. As discussed in the above section, the 1978 flood would have produced deep flows over all of the floodplain surfaces within the meander belt. Moderate floods in both 1980 and 1983 also would have produced at least shallow overbank flows on most of the bar surfaces. The 1987 photos show that the 1978, 1980, and 1983 floods did not change the low-flow channel alignment and floodplain bar configuration set by the 1969 flood. Some of the riparian vegetation the 1969 flood left standing along the new outside low-flow channel bends was removed by the later floods, but overall there was significant recovery of riparian vegetation density. All the terrace banks denuded by the 1969 flood appeared densely vegetated in 1987. Bar units in the upstream half of the site and near the San Miguel Bridge appeared recently disturbed by a combination of flood channel scour and to a lesser degree sediment deposition. By this measure, the bar unit at the Vineyard Creek confluence appears relatively undisturbed, suggesting the 1978 flood overtopped it by much less than the 5-6-ft estimate discussed in the above section. The 1980 and 1983 floods apparently overtopped the bar only along its lower margin and shallowly if at all at its higher elevations. The low-flow channel is substantially narrower in 1987 than it was after the 1969 flood. Downstream from the site the left (west) bank bar unit upstream from the Big Sandy Creek confluence showed somewhat more but still minor disturbance after having been evidently completely scoured and redeposited by the 1969 flood.

Occurring nine years after the large 1978 flood, and four years after the moderate 1983 flood, the 1987 photos may be expected to exhibit similar levels of floodplain disturbance as the 1937 and 1949 photos, the latter of which were made ten and six years, respectively, after moderate floods (1927 and 1943). Compared to those earlier floodplain bar surfaces, the 1987 floodplain surfaces look less completely and much less disturbed. The surface at the Vineyard Creek confluence appears particularly undisturbed.

1994 Air Photos. The September 3, 1994 air photos were made seven years later and following the early 1990s drought period. The 1993 flood was the largest to occur but gage data suggests that it would not have inundated the higher floodplain bar surfaces in the study reach. The photos indicate that 1987-1994 was a period of continuing floodplain vegetation establishment and recovery from the 1969 flood. Former floodplain scour channels were colonized by dense riparian vegetation. The low-flow channel appears to have narrowed somewhat during this period. No measurable bank erosion appears to have occurred. The 1994 air photos are similar to the 1987 photos; only the riparian vegetation became denser.

Vineyard Creek remained in the same alignment, including where it was straightened by the 1969 flood and precursor pilot channels. The section downstream from the Indian Valley Road Bridge was channelized further probably to accommodate agricultural production on the adjacent terrace lands. In so doing, an attempt was also made to shorten and straighten its downstream outlet to the Salinas River bank. The 'direct path' excavated pilot channel was later abandoned by the stream in favor of its former irregular path.

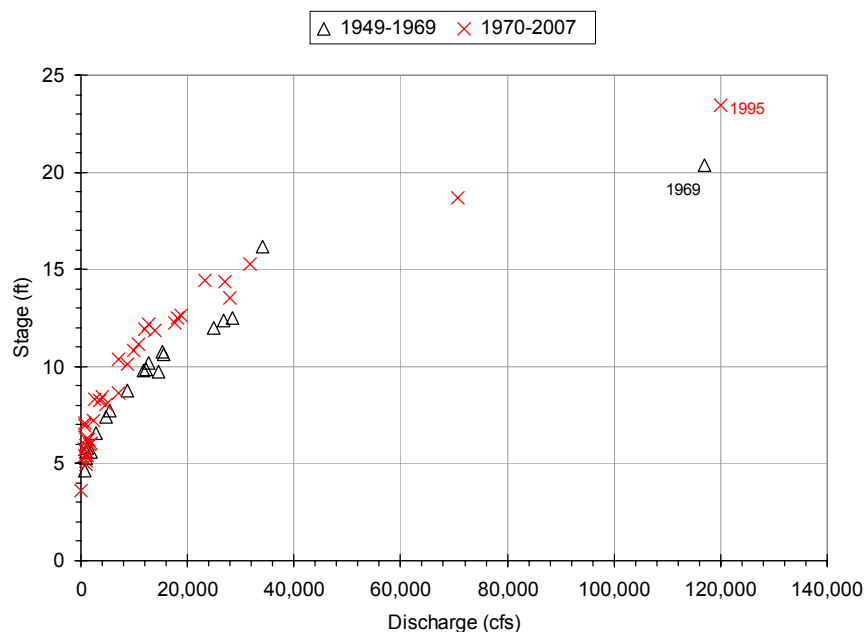


Figure 12. Stage-discharge relations for annual peak flows on the Salinas River nr Bradley (USGS 11150500), 1949-2007 (Source: USGS). Note the approx. 2-3 ft rise in the stage-discharge curve after the 1969 flood.

2002 Air Photos. The May 24, 2002 air photos were made seven years after the 1995 flood. The 1995 flood was approx. the same discharge as the 1969 flood. Surprisingly, however, the 2002 air photos show little change occurred in 1994-2002. In the braided channel section in the upstream part of the Site (south excavation area) vegetated mid-channel bars shown in the 1994 photos were configured nearly the same in 2002. The 1995 flood evidently deposited sediment on large parts of the high bar units here and upstream near San Miguel Bridge. The 1995 flood removed almost none of the riparian vegetation then present in the study reach. The 1995 flood did not appear to measurably widen the low-flow channel. Like the 1994 photos, the 2002 air photos appear almost the same as the

1987 photos; only the riparian vegetation continued to become denser. Lack of upper Salinas River channel change resulting from the 1995 flood is the most surprising and difficult to explain observation from the historical air photos sequence of the Pankey Site.

Stage-discharge data

SDC (2007:14-15) reviewed stage-discharge data from the Paso Robles and Bradley gages 11 miles upstream and downstream from the Site, respectively, finding a slight historical channel bed degradation trend at the downstream gage and a slight aggradation trend at the upstream gage. **geomorph** also retrieved stage-discharge data from the USGS web server and determined there has been: (1) an approx. 2-3-ft *rise* in the stage-discharge curve at the downstream gage (Figure 12); and (2) an approx. 1.5-ft *decline* in the stage-discharge curve at the upstream gage (Figure 13).

These gage records thus indicate that there has been net channel bed degradation upstream from the Site and net bed aggradation downstream from the Site. These results are the opposite of those reported by SDC (2007). The Upper Salinas-Las Tablas Resources Conservation District (US-LT RCD 2004) also found about 2 ft of channel bed degradation at the 13th Street Bridge in Paso Robles (upstream gage site) since 1961, and SDC (2007) found about 1-1.5-ft of bed degradation at the 13th Street Bridge over roughly the same period.

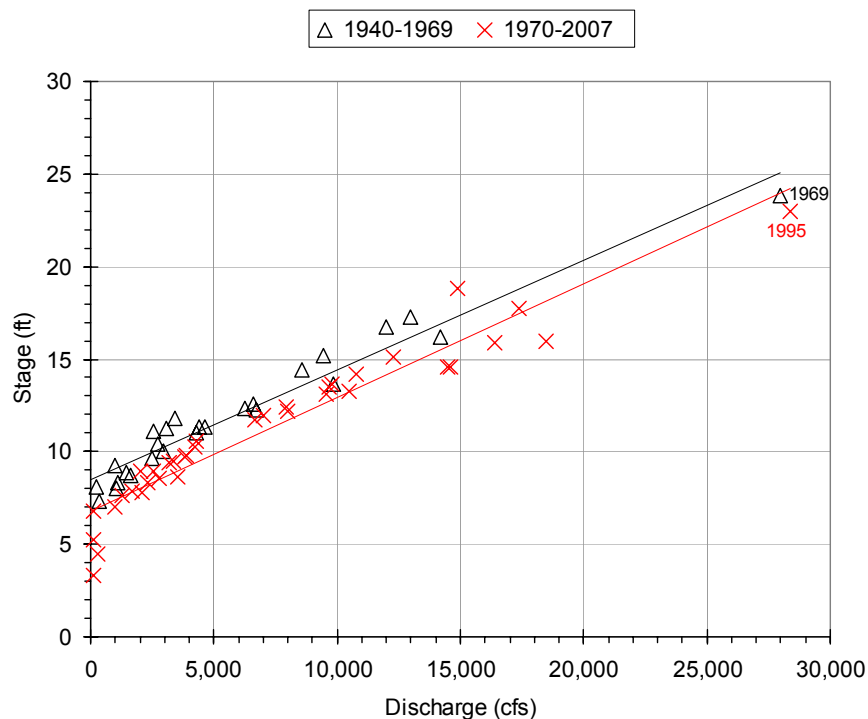


Figure 13. Stage-discharge relations for annual peak flows on the Salinas River at Paso Robles (USGS 11147500), 1940-2007 (Source: USGS). Note the approx. 1.5-ft decline in the stage-discharge curve after the 1969 flood.

Watson et al. (2003:11) developed a “novel method” for using raw USGS stage-discharge field measurement data to sense bed elevation changes over time. They used the

measured flow width corresponding to a given measured discharge as a surrogate for channel bed elevation, which evidently assumes the cross-section profile does not change between measurements. They found a channel bed degradation trend on the mainstem Salinas River downstream from Bradley they partly attributed to the combined influence of sediment trapping on Nacimiento and San Antonio Rivers. They also found net channel bed aggradation on the east side tributary streams. Watson et al. (2003) did not report results of the bed elevation tracking method for sites on the upper Salinas River.

Bridge maintenance records

SDC (2007) compiled low-resolution repeat cross-section data from historical bridge maintenance records at four upper Salinas River bridge crossings upstream from the Site. Three of the bridges are in Paso Robles and one is the San Miguel Bridge immediately upstream from the Site. Repeat cross-section data for three Paso Robles bridges indicate there was 1-3 feet of historical channel bed degradation. The Paso Robles stream gage is located at the 13th Street Bridge (Appendix C-7). Repeat cross-sections there showed approx. 1-1.5-ft of channel-averaged bed degradation between surveys of 1965 and 2004. This amount of bed degradation appears consistent with the 1.5-ft decline in the Paso Robles stage-discharge curve (Figure 13).

The Niblick Road Bridge is about one mile upstream from the 13th Street Bridge. A somewhat greater approx. 2-2.5-ft decline in the average bed elevation has been seen there. The Highway 46 Bridge is about 0.5 miles downstream from the 13th Street Bridge. Repeat surveys showed about 2.5 ft of average bed degradation there between 1953 and 1988 surveys. SDC (2007) did not reproduce cross-section profiles for the San Miguel Bridge but reported that there was an average 1-2-ft decline in the bed elevation between 1970 and 2002. There may be no pre-1969 flood cross-section profiles for the precursor San Miguel Road Bridge from which to estimate the bed elevation change resulting there from the 1969 flood.

Old topographic maps

The most recent USGS 7.5-minute quadrangle maps covering the upper Salinas River watershed area have 20-ft contour interval elevation data developed by USGS from 1947 and 1963 air photos. With their 20-ft contour interval, these maps are generally not of sufficient resolution to compare with recent bed elevation data (e.g., see discussion elsewhere below). These maps do provide a centerline stationing system (in river miles, RM) along the low-flow channel alignment of 1947 and 1963. These 20-ft contour interval bed elevation data and river mile stationing were used to compile the longitudinal profile presented in Section 4 of this Plan showing the locations of bridge crossings, instream mine sites, tributary confluences, and geomorphic subreach breaks.

geomorph searched University of California library resources for additional old maps. A 1953 Army Corps of Engineers (San Francisco District) flood control study referred to cross-section surveys of the upper Salinas River having been made at 1/2-mile intervals from near Templeton (RM 127.4) upstream to Pozo (RM 163.5), but these cross-section data were not contained in the report's appendices. The cross-sections may have been surveyed as part of the analysis for constructing Salinas Dam (completed in 1941). A time consuming search of Army Corps paper document archives may or may not yield these cross-section data. **geomorph** has contacted the San Francisco District and is awaiting referral to appropriate personnel there for guidance re. accessing archival materials. If

these cross-section survey data were archived they are most likely held in microfiche format in Washington, D.C. by contractors to Army Corps.

A 5-ft contour interval topographic map of the Salinas River published by the Department of Interior in 1915 from 1910-1912 survey data extends as far upstream as the Nacimientto River confluence near Bradley, but does not continue into the upper Salinas River.

The earliest USGS 15-minute and 7.5 minute maps were published in 1919 and contain 50-ft contour interval topography. **geomorph** evaluated whether or not these 50-ft contours could be compared to the later 20-ft contour interval maps to evaluate general bed elevation trends by transposing the 1919 spot contour data onto the 1947 & 1963 longitudinal profile:

- the 600-ft contour on the Salinas (near the Estrella confluence) moved approx. 3,000 ft upstream from 1919 to 1947 (degradation trend);
- the 600-ft contour on the *Estrella* (near the Salinas confluence) moved approx. 4,000 ft upstream from 1919 to 1947 (degradation trend);
- the 700-ft contour on the Salinas (near Paso Robles vicinity) moved approx. 4,000 ft upstream from 1919 to 1947 (degradation trend);
- the 700-ft contour on the *Estrella* (near Estrella) moved approx. 500 ft downstream from 1919 to 1947 (aggradation trend); and,
- the 800-ft contour on the Salinas (in Atascadero vicinity) moved approximately 3,000 ft downstream from 1919 to 1947 (aggradation trend).

Strictly speaking, these contour shifts are only rough estimates because it is not known how well the survey and/or photogrammetry methods compare, and to what extent the location where the streamline crosses a given contour interval best represents either the average low-flow channel bed elevation or overall average active channel bed elevation at that location. The 1919 and 1947 maps apparently indicate channel averaged bed elevations rather than true thalweg or low-flow bed elevation data. For example, the 1947 map shows the 580-ft contour crosses the Salinas River bed approx. 1,000 ft downstream from the Vineyard Creek tributary confluence. Converting the 1947 elevation data from NGVD 1929 vertical datum to the NAVD 1988 datum by adding 3.06 ft (according to datum shift data retrieved from VERTCON http://www.ngs.noaa.gov/cgi-bin/VERTCON/vert_con.prl), the single spot elevation taken directly from the 1947 USGS map is about 10 ft higher than the precise 2005 bed elevation there.

None of the other 20-ft contours shown in the 1947 and 1963 maps are near enough to accurate historical bed elevations, such as for the bridges in Paso Robles, to evaluate relative accuracy. In general, none of the available topographic map data are sufficient for constructing comparable historical longitudinal profiles for evaluating long-term degradation and aggradation trends on the upper Salinas River.

Measured historical low-flow channel width fluctuations

The upper Salinas River low-flow channel width fluctuates as the result of flood and drought cycles. In the above section, a sequence of historical air photos was interpreted in narrative format to characterize the physical responses to individual large and moderate floods and

intervening periods of relatively low flooding. Fluctuations in the low-flow channel width were observed. **geomorph** measured the average low-flow channel width within the strongly single-thread meandering subreach in the northern half of the site (northern excavation area) for each photo year to document actual historical fluctuations to the extent the available data allow (Figure 14). Figure 14 shows that the low-flow channel was about 180 ft-wide before the 1969 flood. The 1969 flood almost doubled the channel width. The low-flow channel has progressively narrowed since the 1969 flood. The moderately large 1978 flood and the large 1995 flood did not appear to cause channel widening; the 1995 flood appeared to produce none. The 2002 low-flow channel is the narrowest of those years measured.

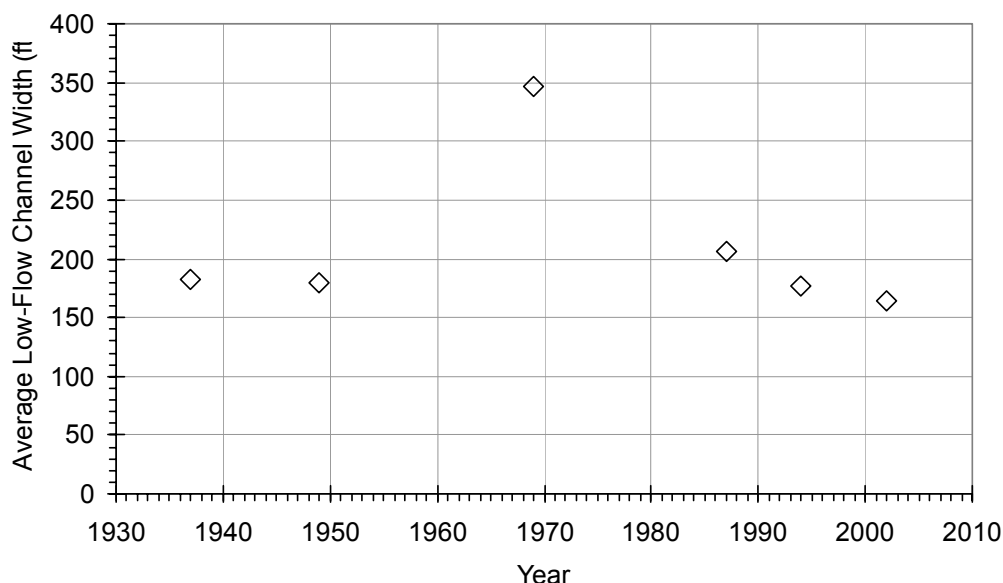


Figure 14. Average low-flow channel width measured from a sequence of historical air photos of the Salinas River within the proposed Pankey Sand and Gravel Mine site north excavation area (1937, 1949, 1969, 1987, 1994, and 2002).

3.4 Summary of long-term geomorphic trends on the upper Salinas River near the Pankey Site

The above historical geomorphic analysis generally suggests that the upper Salinas River is undergoing a number of historical geomorphic trends near the Site. First, Salinas River low-flow channel bed elevations have decreased about 2 ft upstream from the Site, perhaps most markedly during and after the 1969 flood. The 1969 flood probably severely undermined the historical San Miguel Bridge piers immediately upstream from the Site (the bridge was destroyed), but the bed probably at least recovered its pre-flood elevation and may have actually aggraded by the end of the flood. This appears true because the flood carved a new low-flow channel that was almost twice as wide as the pre-flood channel; geomorphic reasoning suggests that the over-widened channel may be somewhat shallower. Repeat bridge cross-section surveys made during the 1970 replacement of the San Miguel Bridge and the recent 2003 replacement of the bridge show the low-flow channel bed downcut an average of 1-2 feet during 1970-2002 (SDC 2007).

Second, the Salinas River bed elevations have probably increased over time beginning several miles downstream from the site. The bed appears to have aggraded 2-3 ft at the Bradley stream gage. Note, however that SDC (2007) and Watson et al. (2003) found the opposite trend at the Bradley gage vicinity, using different methods. If indeed there has been aggradation, it may be related to smaller peak flow contributions by the Nacimiento River discharging to the Salinas River just upstream of the Bradley gage. The Nacimiento River was regulated beginning in 1957. It appears much of the estimated 2-3 ft bed aggradation may have occurred as the direct result of the 1969 flood.

In general, this historical analysis implies that the 1969 flood delivered an extremely high sediment load to the upper Salinas River including the study reach. The 1969 flood reconfigured the entire meander belt width of the Salinas River near the Site and destroyed about 80% of the pre-flood riparian vegetation. The 1969 flood left hundreds of feet of severely eroded bare terrace banks within the Site. The 1969 flood appears to have caused net floodplain bar and low-flow channel aggradation within the study reach, possibly averaging more than two vertical feet on the resulting low-flow channel bed and one vertical foot on floodplain (coarse-grained bar) surfaces.

Third, since the 1969 flood, approx. 2 ft of channel bed downcutting has probably occurred within the Site and over tens of miles upstream from the Site. The low-flow channel has remained in the same alignment but contracted to its pre-flood width. Fourth, floodplain disturbance has reduced markedly since the 1969 flood. Air photos indicate that the upper Salinas River has otherwise changed very little. Riparian vegetation has reestablished on the severely eroded terrace and low-flow channel banks. Remnants of pre-flood riparian vegetation have remained intact and expanded. The highest floodplain (coarse-grained bar) surfaces appear have sustained relatively little flood disturbance. This is despite the fact that the 1978 flood and the 1995 flood were presumably large enough to have overtopped all of the floodplain surfaces by more than 5-6 feet. Presently there is more mature riparian vegetation within the corridor than shows in the 1939, 1947, 1969, 1987, 1994, and 2002 air photos – possibly more than at any time since before the 1862 flood.

It is remarkable that the 1995 flood produced almost no measureable channel change within the Study Reach. The 1995 flood was approx. the same magnitude as the 1969 flood. Part of the explanation may be that the 1969 flood was longer duration and may have been at times carrying much higher sediment concentrations; cumulatively the event appeared to cause massive sediment deposition within the site and extending at least tens of miles downstream. For example, it may be that the 1969 flood was preceded by significantly more total rainfall than the 1995 flood (e.g., Figure 15), such that the 1969 flood carried orders of magnitude more sediment resulting from hillslope failures and releases from channel storage in the upper watershed areas.

geomorph did not undertake precipitation data gathering and analysis for comparing the antecedent conditions of the two floods, but it is generally understood that the geomorphic effects of the 1969 flood were extraordinarily high in Central and Southern Coastal California watersheds, and much higher than those of the 1995 flood. Whatever the explanation, the observed net bed aggradation within and downstream from the site after the 1969 flood corresponds well with the observed channel bed downcutting higher in the watershed following the same storm. Likewise, the net downcutting trend observed after the 1969 flood corresponds to an expected adjustment to the aggradation caused by the flood.

Lack of floodplain disturbance by the 1995 flood does not appear explained only by post-1969 flood channel bed degradation adjustment (e.g., as may be presumed to increase the

channel capacity and reduce overbank flows). The 1995 flood was so large that it still would have produced substantial overbank flows. But air photo evidence (e.g., Appendix B) indicates that the evidently shorter duration flood had a minor geomorphic effect on the system.

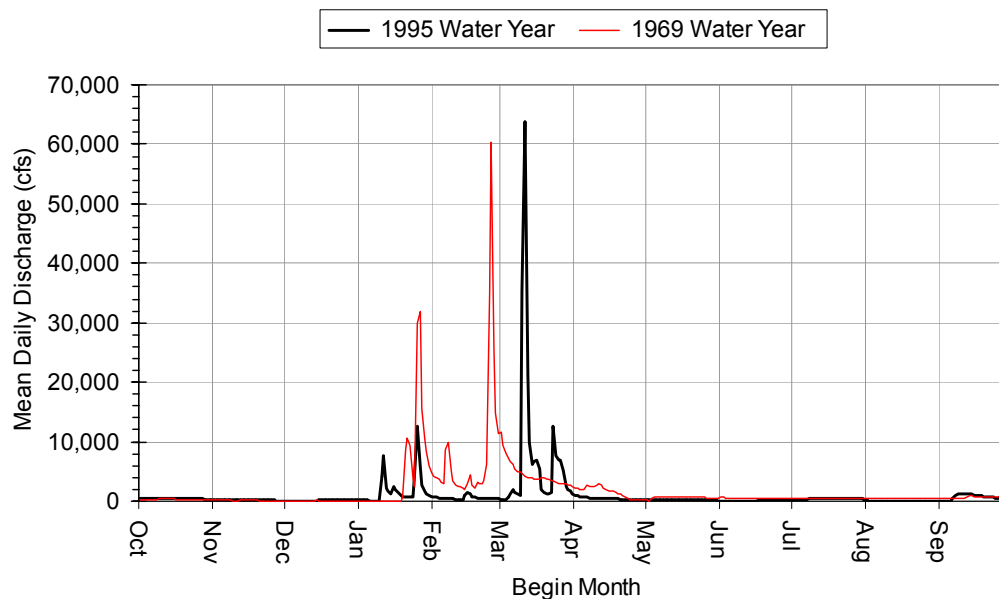


Figure 15. Annual mean daily flow hydrographs for the 1969 and 1995 water years measured on the Salinas River nr Bradley (USGS 11150500) drainage area 2,535 sq mi. The Bradley gage is downstream from the regulated Nacimiento River. The 1969 water year produced more peaks exceeding 10,000 cfs and longer duration higher winter baseflows between individual flood peaks. (Source: USGS)

The current floodplain (coarse-grained bar) structure and overall conditions within and near the Site are the result of the 1969 flood. Moderate floods since the 1969 flood have caused a few feet of horizontal bank erosion over long reaches and several feet at some specific locations, with associated riparian vegetation losses but the modern trend appears to be one of significantly reduced floodplain surface disturbance. Most of the mature riparian vegetation at the Site is today about 40 years old having been established just after the 1969 flood. Reduced floodplain disturbance comes with reduced recruitment of new riparian vegetation. The riparian forest is increasingly older and even-aged.

Floodplain bar units within and downstream from the Site that appeared recently significantly disturbed in 1937 and 1949 air photos were not disturbed by the larger 1978 and 1995 floods. These trends do not appear explained only by the presumed approx. 2 ft of bed incision occurring during and/or after the 1969 flood. Rather they may be related also to massive floodplain aggradation during the 1969 flood, for which there is field evidence of at the Site (e.g., several-ft-high coarse-grained bars deposited on the former floodplain surface leeward of mature riparian trees which survived the flood).

Fifth, air photo evidence suggests that formerly nearly braided channel sections of the upper Salinas River may be converting to single-thread meandering form. This conversion may not be gradual; the 1969 flood appears may have been a root cause of this conversion. Overall, this analysis highlights the extraordinary nature of the 1969 flood effects. Indeed, a Bureau of Reclamation paleoflood study (USBR 1996) estimated that the 1969 flood was

an approx. 700-year flood on the Santa Ynez River. Air photo evidence clearly substantiates that, geomorphically, on the upper Salinas, the 1969 flood was extraordinarily more effective than the 1995 flood.

The observed trend toward much reduced floodplain disturbance and vegetation recruitment on the higher bar surfaces needs to be distinguished from vegetation disturbance-recovery cycles on the terrace and low-flow channel banks and on mid-channel bars (islands) within the low-flow channel. These processes appear adequately forced by the typical moderate and low floods on the Salinas, producing low-flow channel bedforms similar to those seen in the earliest air photos.

4. A PRELIMINARY UPPER SALINAS RIVER SEDIMENT BUDGET FOR AREA-WIDE SAND AND GRAVEL RESOURCES MANAGEMENT

4.1 Introduction

SDC (2007) initially estimated the upper Salinas River sediment replenishment rate at the Pankey Sand and Gravel Mine site (Site) by applying a unit sediment yield estimate calculated from the long-term measured Santa Margarita Reservoir sedimentation rate data of Glysson (1977).

CDFG (2008) questioned the technical justification of values and factors SDC (2007) used to estimate the sediment replenishment rate including: (1) direct v. factored drainage area extrapolation of the Santa Margarita Reservoir unit sediment yield to the Site's larger contributing drainage area; (2) sediment density conversion factor of 1.0 tons/CY; and (3) general representativeness of upper watershed reservoir sedimentation data of Glysson (1977) (related to 1). CDFG (2008) also generally recommended annual maximum sediment extraction rates for instream mines be conditioned not only to not exceed a percentage of the Site's estimated annual average sediment replenishment rate but also according to the results of a to-be-determined watershed-scale cumulative impacts evaluation of the many existing active and proposed new instream mines in the upper Salinas River system. For example, a watershed-scale sediment budget may show that existing and proposed instream mines reduce the amount of natural replenishment delivered and potentially available for sustainable mining at downstream sites. Such a sediment budget can be used as a primary tool for avoiding cumulative impacts of proposed new instream mines.

In reviewing potential cumulative impacts of a separate instream mine Conditional Use Permit (CUP) application ("Weyrick"), Balance (2008) selected sediment rating curves developed from sediment transport measurements on other rivers in the region and applied them to the mean daily flow record on the Salinas River at Paso Robles to estimate the annual total sediment yields there. In so doing, Balance (2008) demonstrated there is considerable interannual variation in annual total sediment yield within the Salinas River system, characteristic of rivers draining California's Mediterranean (or practically Sonoran) climate watersheds. The interannual variation is such that extraction of 50% of the annual average sediment replenishment rate would exceed the estimated actual annual sediment replenishment rate in about 75% of years.

In considering both CDFG (2008) and Balance (2008), SDC (2008) clarified that: (1) the upper watershed unit sediment yield estimate of Glysson (1977) should not be considered unrepresentatively high because it is much less than the alternative unit sediment yield developed for Paso Robles vicinity by Balance (2008); (2) using a regional drainage area – unit sediment yield relation may not be reliable for adjusting unit sediment yield to the Site because the available relations generally contain order-of-magnitude variation; and (3) the measured *in situ* bed sediment density at the site is 1.3 tons/CY. As an alternative to drainage area – unit sediment yield relations, SDC (2008) proposed instead using arbitrary percentage reductions (e.g., 25% and 50% less) of the directly estimated Site sediment replenishment rate to roughly account for unknown watershed position effects. And as consideration of cumulative impacts SDC (2008) tabulated the permitted annual maximum extraction rates for a list of currently active and proposed future instream mines upstream from the Site. SDC (2008) also adjusted these cumulative total annual maximum upstream extraction rates by 25% and 50% reductions to roughly account for years when actual

extraction is less than the annual maximum permitted amount. SDC (2008) compared the 50%- and 25%-reduced values of the estimated replenishment rate to the range of values for estimated total upstream mine extraction, including full permitted extraction. According to SDC's simplified but reasonable analysis, the 'worst-case' annual outcome was only 36% of the total sediment replenishment would pass through the Pankey Site to the Salinas River downstream from the Site. The 'best-case' outcome was 83% passing. For more information about previous work, see Section 2.2 for detailed summary of these individual documents, and original documents in the project record.

geomorph finds that while none of the current estimates of average annual bedload sediment replenishment rate in the project record are completely satisfactory, the project record does contain 'best available information' for preparing an independent estimate of replenishment rates at locations along the mainstem upper Salinas River that is sufficient for conditioning annual maximum extraction rates for new proposed instream mines according to a watershed-scale sediment budget – an adequate technical basis for conditioning new projects especially within an adaptive management type management and monitoring context.

This Plan issues recommended 'best available information' estimated existing conditions bedload sediment budgets and sediment bypass rates for the Salinas River and tributary Vineyard Creek at the Pankey Site location, as well as for each of five individual geomorphic subreaches comprising the 30.22-mile-long alluvial mainstem upper Salinas River in San Luis Obispo County. The existing conditions replenishment rates have been reduced by a percentage of the sum total of the annual maximum permitted extraction rates for all of the existing permitted instream mines upstream from the Site – all of the mines on the 27-mile-long section of the mainstem alluvial river upstream from the Site and all of the tributary stream mines lying within 10 miles from the mainstem. How much the replenishment rate and percent bypassed would be further reduced by the proposed new instream mines upstream from the Site is evaluated in Section 6.3. These subreach sediment budgets are provided as a preliminary technical basis for the proposed area-wide management and monitoring plan. The budgets also provide a technical basis for evaluating the cumulative impacts of the proposed Pankey Project alone or in combination with the other proposed new instream mines. This Plan highlights project approval scenarios that achieve minimum 50% sediment bypass for the Pankey Site as well as the larger S-1 and S-2 subreaches of the mainstem river which are subject to potential cumulative impacts of proposed new instream mines.

Two important factors deserve some discussion here in this introduction. First, it is difficult to estimate how much sediment extraction from the existing and proposed new upstream instream mines actually reduces the availability of sediment at the Site and within the individual subreaches. This is mainly because sediment extraction data for individual existing mines are proprietary not public information. In October 2008, the County obtained extraction or production data reported to the State Office of Mine Reclamation (OMR) aggregated over the most recent 7-year period for nine mines including four of the seven existing instream mines on the mainstem upper Salinas River. Those data indicated that the nine mines extracted an annual average of 153,800 CY/yr over that period, or about 47% of their total permitted maximum rate. Data from the City of Paso Robles indicates that mining from the other three existing instream mines during the same period totaled much less than 50% of the permitted maximum rate. Overall, these aggregated data suggest that the existing instream mines in the system actually extract sediment at approx. 50% of their total permitted rate ("50% mining rate"). That these mines are mining at 50% suggests that extraction and production are limited by actual replenishment and/or market demand. A review of all mine permit and annual inspection report

information obtained from County, City, and State offices (Appendix L) indicates that mining extraction rates are routinely limited by at least four factors in approximate order of most reported to least reported factor:

1. failure to secure necessary permits;
2. insufficient annual replenishment;
3. limited market demand; and,
4. presence of shallow groundwater.

These limiting factors very well could change over the next 7-year period. There are also two proposed new instream mines upstream from the Pankey Site that have pending permit applications with unknown outcomes. Overall, it can be seen that there is generally no technical basis for projecting actual future extraction rates, but future production rates can potentially be routinely and inexpensively monitored.

Second, there is considerable interannual variation in the actual sediment replenishment to sites on the upper Salinas River due to the Mediterranean or Sonoran climate. For example, Balance (2008) used regional envelope sediment transport curves and Paso Robles stream gage data to show that the long-term annual average sediment load is probably exceeded in fewer than 25% of years. Balance (2008) used these estimates to show that if a mine extracts as much as 50% of the estimated annual average sediment replenishment, it may be extracting more than the actual replenishment in most years, and possibly for multiple years in a row. Still, most existing and all proposed new instream mines should or will have maximum total extraction depth requirements, or “redlines”, which prevent operators from extracting below a fixed trench floor elevation. Redlines prevent operators from extracting more sediment than replenishes the site. That is, during extended duration drought cycles, insufficient sediment might deposit within a “redlined” mining area to allow cost-effective extraction to commence for a few to several years. Low sediment replenishment during relatively dry periods may partially explain why in recent years the existing mainstem instream mines have collectively been extracting only about 50% of the total maximum permitted amount. Air photos show that many existing permitted mines have not been mined recently (e.g., mining extraction areas are covered with dense vegetation). There is generally no technical basis for projecting future interannual variation and predicting specific effects of future extended duration drought cycles. For the purposes of conservatively analyzing and avoiding cumulative impacts, this Plan proposes redlines for avoidance and minimization of drought cycle effects and an adaptive management type monitoring plan for achieving additional avoidance and allowing for special mitigation measures to protect environmental resources if necessary (see Section 6).

Approach. In this section of the Plan, **geomorph** takes the following approach to compiling a ‘best available information’ sediment budget for the mainstem upper Salinas River and estimating sediment budget effects of the existing permitted and proposed future instream mines:

1. delineate the mainstem upper Salinas River into geomorphic subreaches with similar hydrology, sediment supplies, and sediment supply source areas (Section 4.2);
2. arrive at ‘best available information’ unit sediment yield data to estimate natural bedload sediment supply for the Salinas River and tributary Vineyard Creek at the Site and for the Salinas River for each individual subreach (Section 4.3); and,
3. compile “existing conditions” mining-reduced bedload sediment budgets and percent sediment bypass estimates for the Site and each individual subreach by reducing the

estimated natural supply by a percentage of the total annual maximum permitted extraction occurring on and within 10 river miles from the mainstem upstream from the Site/subreach (Section 4.4).

geomorph submits that the resulting existing conditions bedload replenishment rate for Reach S-1 (see Section 4.4) is sufficiently conservative for conditioning the annual maximum permitted extraction rate for the proposed new Pankey Sand and Gravel Mine Project in a manner that would substantially avoid and minimize cumulative impacts.

In Section 6.2 of this Plan, **geomorph** quantifies the sediment supply limitations for permitting the three proposed new instream mines as they are currently proposed while at the same time demonstrating achievement of 50% annual average bedload sediment bypass for the affected subreaches of the mainstem river. Adequate sediment continuity can only be achieved for certain project approval scenarios. **geomorph** also recommends an adaptive management type monitoring plan for the Site and Reach S-1 (see Section 6.5) be implemented for additional avoidance and allowing for a County-appointed expert monitor to evaluate whether operating the mine according to the permit conditions still causes significant impacts requiring implementation of special mitigation measures during the Project lifetime.

4.2 Geomorphic subreaches of the mainstem upper Salinas River

The mainstem upper Salinas River and its major tributary streams can be divided into individual geomorphic subreaches according to basic geomorphic reasoning. The first level of organization is according to the individual major subwatersheds in the system. The individual subreaches comprising the system are: (1) streams draining the major individual tributary subwatersheds; and (2) individual segments of the mainstem stream lying between individual tributary subwatershed outlets. This level of organization is appropriate for analyzing cumulative sediment supply and budget effects both because it is oriented in the direction of sediment transport, and it takes into account what major differences in hydrology and sediment supply and sediment supply sources might exist. Individual subreaches may be further subdivided according to other controls on hydrology and sediment supply, including reservoirs, instream mines, and any particularly influential sediment supply sources such as reaches with headcuts or accelerated bank erosion, or smaller tributary streams with exceptionally high sediment runoff.

Swanson and Kondolf (1991) and Kondolf and Swanson (1993) provide an example of delineating an approx. 27-mile-long mainstem river reach without major tributaries into individual subreaches based on geomorphic analysis of historical channel change induced by reservoir construction and distribution of smaller and larger instream mines (Figure 16).

The upper and lower watershed areas of the Salinas River system are separated by a steeper, narrower 'canyon' reach to which the regulated Nacimiento and San Antonio Rivers are tributary near Bradley. As previously defined by the Upper Salinas-Las Tablas Resource Conservation District (2004), the upper Salinas River lies upstream from the regulated Nacimiento River tributary confluence near Bradley, and the approx. 2,000-sq-mi upper Salinas River watershed area includes the regulated Nacimiento River watershed (Figure 9). Figure 17 shows the mainstem upper Salinas River and its major tributaries: Nacimiento River, Estrella River, and Huerhuero Creek. The Nacimiento River watershed is outside the scope of this Plan because it discharges at the downstream end of the upper Salinas River. The lowermost 3.4-mile-long section of the river lies within Monterey County.

In organizing a preliminary cumulative impacts analysis for the proposed Weyrick instream mining project near Paso Robles, Balance (2008) delineated two subreaches of the mainstem upper Salinas River: Reach A extended from a location 9 miles upstream of Paso Robles to 3 miles upstream from Paso Robles; and Reach B extended from 3 miles upstream from Paso Robles to the Estrella River confluence about 1.25 miles upstream from the Pankey Site, including the tributary Huerhuero Creek watershed. **geomorph** recommends splitting Reach B of Balance (2008) into two individual subreaches at the Huerhuero Creek tributary confluence. The location approx. 3 miles upstream from Paso Robles is selected at mainstem river mile (RM) 125.00, about 2.81 miles upstream from the 13th Street Bridge. The location approx. 9 miles upstream from Paso Robles is selected for field and air photo landmark purposes as the overhead power line just a few hundred feet upstream from the Paso Robles Creek confluence (at RM 130.56).

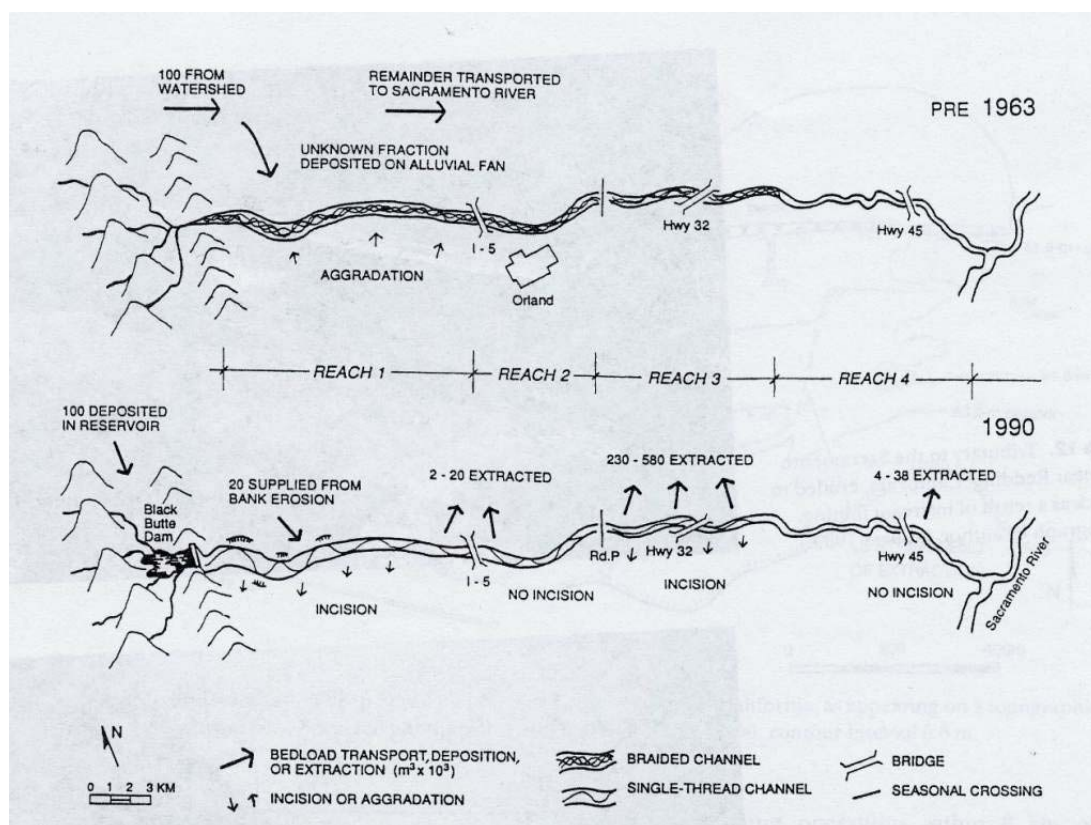
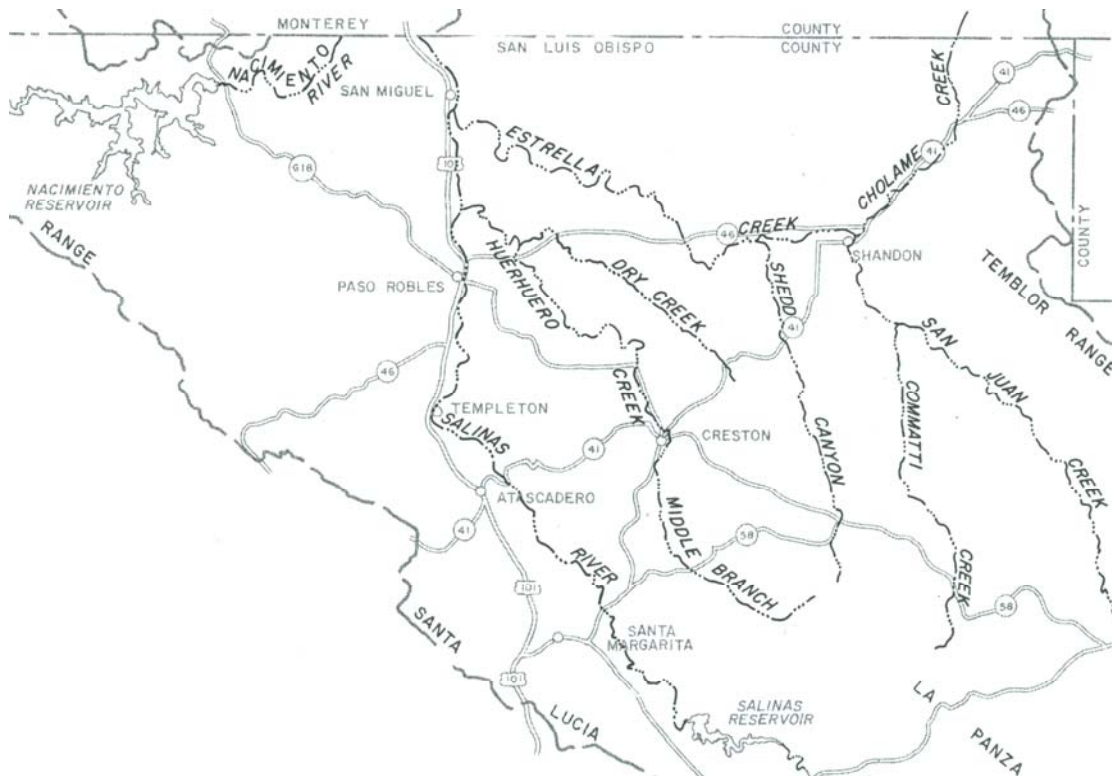


Figure 16. Diagrammatic illustration of bedload sediment budget for Lower Stony Creek in Tehama County, California prior to construction of Black Butte Dam in 1963 and after dam construction, as of 1990. All values of gravel flux are in 1,000s of cubic meters per year. Multiply by 0.76 to convert to 1,000s of CY/yr. (Source: Kondolf and Swanson 1993).

geomorph submits that the following geomorphic subreaches adequately represent the practical variation in the hydrology and fluvial geomorphology and other identified sediment supply controls of the upper Salinas River system and thereby provide an appropriate network hierarchy of individual and cumulative mining impacts suitable for evaluating the potential cumulative impacts of the Project:

- upper Salinas River between Nacimiento River and Estrella River confluences;
- upper Salinas River between Estrella River and Huerhuero Creek confluences;
- upper Salinas River between Huerhuero Creek and approx. 3 miles upstream from Paso Robles [approx. same as Reach A of Balance (2008)];
- upper Salinas River from approx. 3 miles upstream from Paso Robles to approx. 9 miles upstream from Paso Robles;
- upper Salinas River from approx. 9 miles upstream from Paso Robles to approx. 5 miles upstream from Atascadero (upstream limit of semi-confined or unconfined alluvial conditions);
- upper Salinas River from approx. 5 miles upstream from Atascadero to Salinas Dam/Santa Margarita Reservoir (canyon reach);
- upper Salinas River upstream from Santa Margarita Reservoir.

- Estrella River
- Cholame Creek (tributary to Estrella River);
- San Juan Creek (tributary to Estrella River);
- Huerhuero Creek



geomorph DESIGN

Geomorphic subreaches potentially subject to cumulative instream mining impacts

According to information recently provided by the County of San Luis Obispo (County), the City of Paso Robles (City), and the State Office of Mine Reclamation (OMR), there are nine (9) existing permitted instream mines in the upper Salinas River watershed, one (1) newly permitted instream mine that has yet to begin operating, and four (4) proposed new instream mines that are under permit review. The distribution and effects of these existing and proposed instream mines on the bedload sediment budgets for the individual mainstem tributaries are evaluated in more detail in Section 4.4. Here, the distribution of instream mines is first reviewed for the purposes of establishing which mainstem and tributary geomorphic subreaches are potentially affected by cumulative impacts of instream mining for the purpose of scoping an area-wide monitoring plan and selecting geomorphic subreaches to cover that Plan area.

There are seven (7) existing permitted and three (3) proposed new instream mines on the mainstem upper Salinas River. There are two (2) existing permitted instream mines on tributaries. One (#27 Navajo Creek) is on Navajo Creek, a tributary to San Juan Creek more than 35 river miles from the mainstem upper Salinas River. The other (#52 Creston) is on Huerhuero Creek near Creston, about 15 river miles from the mainstem upper Salinas River. **geomorph** deems these existing tributary mines have a negligible impact on the bedload sediment budget of the upper Salinas River due to their distance from the river. It does not appear necessary to designate individual geomorphic subreaches to these tributaries.

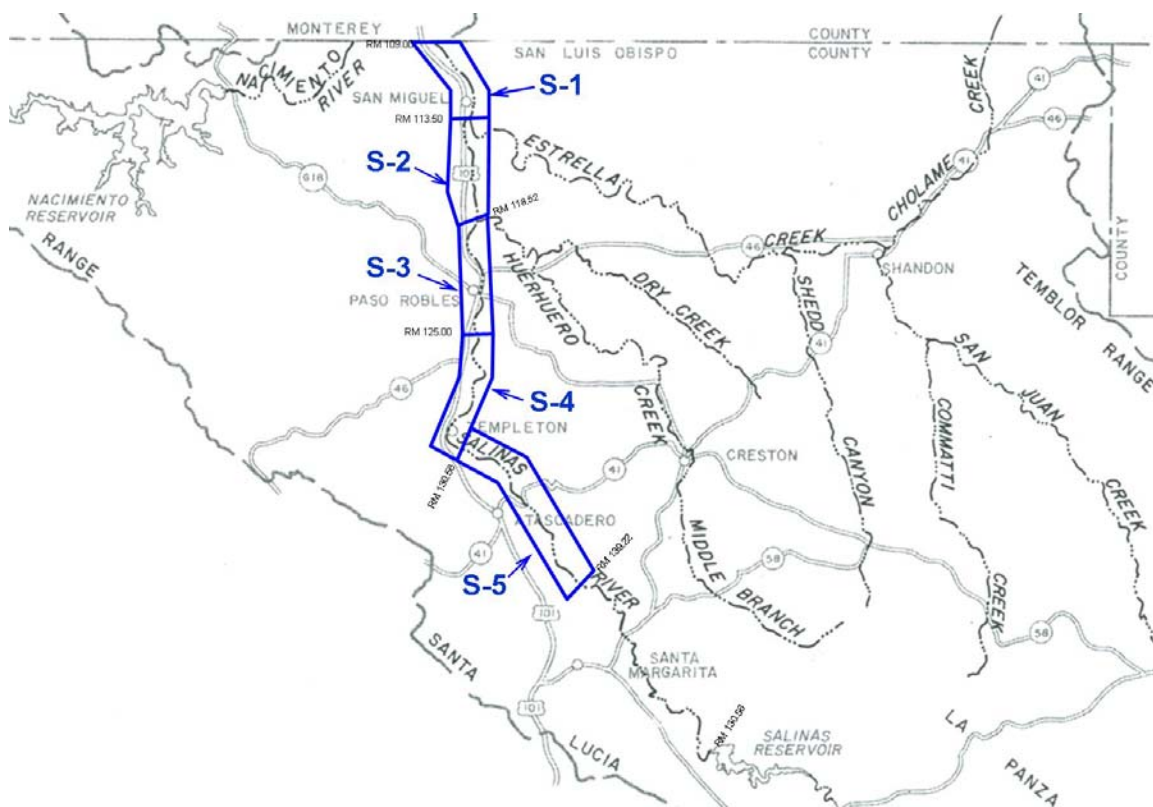


Figure 18. Geomorphic subreaches comprising the entire 30.22-mile-long alluvial portion of the mainstem upper Salinas River within San Luis Obispo County potentially subject to cumulative impacts of multiple existing permitted and proposed new instream mines.

There is one (1) newly permitted instream mine (Viborg-Estrella) on the tributary Estrella River that has not begun operating at its location about 5.5 river miles upstream from the river (Appendix C-8). The new Viborg-Estrella mine is the only instream mine on the Estrella River and has potential sediment budget impacts on the lowermost 5.5 river miles of the Estrella River and the mainstem upper Salinas River downstream from the Estrella River confluence. **geomorph** deems that sediment budget effects of the Viborg-Estrella mine on both the Lower Estrella River and the upper Salinas River can be evaluated in this Plan without designating an individual geomorphic subreach for the Estrella River tributary. For one, the Viborg-Estrella mine can be evaluated in so far as it reduces the sediment replenishment rate on the mainstem Salinas River downstream from the Estrella River confluence.

There are two (2) proposed new instream mines on smaller tributaries San Marcos Creek and Vineyard Creek. The proposed San Marcos Creek project is a relatively small project to remove sediment accumulated in stock ponds and so would have a negligible impact on the bedload sediment budget of the upper Salinas River. Sediment removal from Vineyard Creek is proposed as a smaller and partly County Department of Public Works recommended or endorsed element of the Pankey Project (i.e., to formalize frequent channel bed dredging in the vicinity of Indian Valley Road Bridge crossing). **geomorph** deems that sediment budget effects of proposed new mines on both Vineyard Creek and San Marcos Creek and the upper Salinas River downstream from those tributaries can be evaluated in this Plan without designating individual geomorphic subreaches for the Vineyard Creek and San Marcos Creek. This Plan recommends measures for avoiding and minimizing potential impacts to Vineyard Creek in Section 5 and outlines monitoring work for Vineyard Creek the recommended S-1 Monitoring Plan in Section 6.

Table 1.

Geomorphic subreaches of the mainstem upper Salinas River listed in the upstream to downstream direction for evaluation of cumulative instream mining impacts on the bedload sediment budget. Subreaches correspond to Figure 18.

Subreach	Description	Downstream	Upstream	Length
		End (RM)	End (RM)	
Reach S-5	Upper Salinas River between approx. 9 mi upstream from Paso Robles to approx. 5 mi upstream from Atascadero	130.56	139.22	8.66
Reach S-4	Upper Salinas River between approx. 3 mi upstream to approx. 9 mi upstream from Paso Robles	125.00	130.56	5.56
Reach S-3	Upper Salinas River between Huerhuero Creek and approx. 3 mi upstream from Paso Robles	118.52	125.00	6.48
Reach S-2	Upper Salinas River between Estrella River and Huerhuero Creek confluences	113.50	118.52	5.02
Reach S-1	Upper Salinas River between County Line and Estrella River confluence	109.00	113.50	4.50
<i>Total Study Reach:</i>		<i>109.00</i>	<i>139.22</i>	<i>30.22</i>

Notes

Reach A of Balance (2008) approx. same as Reach S-3 and Reach S-2 combined.

Reach B of Balance (2008) approx. same as Reach S-4.

RM is river miles in miles measured along the centerline mainstem Salinas River as established by USGS on quadrangle maps.

Lowermost 3.4 river miles of Upper Salinas River as defined by Upper Salinas-Las Tablas RCD (2004) is in Monterey County.

In summary, the primary impacts of the existing permitted and proposed new instream mines would occur along the alluvial portion of the mainstem upper Salinas River downstream from the upstream most instream mine. The upstream most instream mine is an existing permitted mine in Atascadero (#42 Borzini South) at river mile 133.90 just downstream from the Highway 41 bridge (Appendix C-1). The alluvial portion of the river ends about 5 miles upstream from the Borzini South mine near the Santa Margarita Creek tributary confluence and the Santa Clara Road crossing. This Plan focuses on the entire 30.22-mile-long alluvial portion of the mainstem upper Salinas River within the County of San Luis Obispo. The reach is comprised by five geomorphic subreaches between the County Line on the North and the Santa Clara Road Bridge about 5 miles upstream from Atascadero (Figure 18, Table 1). Authors of future more detailed versions of the area-wide adaptive management type monitoring plan outlined in this Plan may elect to expand the scope of the plan to subdivide the mainstem more finely (such as by designating individual subreaches for each of the individual existing and proposed instream mines), or to designate subreaches and monitoring for upper Salinas River tributaries.

4.3 Estimated annual average natural bedload sediment supply to individual subreaches of the mainstem upper Salinas River

As reviewed in Section 4.1, the current project record does not contain a satisfactory bedload sediment replenishment rate estimate for conditioning the annual maximum extraction rate for the proposed Pankey Project and evaluating cumulative impacts. This section of the Plan uses 'best available information' to estimate the natural bedload sediment supply or replenishment rate to the individual geomorphic subreaches comprising the mainstem upper Salinas River. These natural supply estimates will enter into the supply side of the mining-reduced existing conditions and proposed conditions sediment supplies estimated for individual locations and geomorphic subreaches in Sections 4.4 and 6.2, respectively.

Representative unit area bedload sediment yield for upper Salinas River watershed area

Watson et al. (2003) reviewed the existing available sediment transport measurement and reservoir sedimentation rate data for the larger approx. 4,200-sq-mi Salinas River watershed. USGS collected sediment transport data in the lower watershed at the Spreckles stream gage. These measurements were made in the low-gradient depositional reach of the Lower Salinas River subject to effects of rising sea level and can not be used to reliably estimate the unit sediment yield for the upper Salinas River watershed area. Watson et al. (2003) also collected some new sediment transport data in approx. 2001-2002 at selected locations in the watershed, but these data are too scant for developing a long-term average unit sediment yield for the upper Salinas. Balance (2008) used regional envelope sediment transport curves and Paso Robles stream gage data to estimate the long-term annual average sediment load for the upper Salinas River at the Paso Robles stream gage. Although developed using "high" and "low" envelope sediment transport curves deemed appropriate by Balance (2008) for bounding the likely variability in actual sediment load at the gage site (390 sq mi), the resulting unit area sediment yields are approx. 3 times greater than those estimated for a smaller upstream watershed area (112 sq mi) by Glysson (1977) from repeat reservoir bathymetric cross-section surveying techniques at Santa Margarita Reservoir. Because sediment transport calculations from rating curves can sometimes overestimate actual sediment transport, and reservoir sedimentation rate data are generally a more reliable measurement of unit area sediment yield, the reservoir sedimentation rate data of Glysson (1977) are used in this section as the primary basis for

estimating the representative unit area sediment yield of the upper Salinas River watershed area.

Glysson (1977) surveyed 31 bathymetric sections (ranges) across Santa Margarita Reservoir in 1975 and compared survey results to 1941 pre-reservoir topographic data to estimate that there had been in the 34 years between 1941 and 1975 approx. 2,800 ac-ft of sedimentation within the reservoir below the spillway and 600 ac-ft of reservoir-induced sedimentation above the spillway elevation. Glysson (1977:5) used equations of Brune (1953) to estimate that the reservoir had trapped 98% of all of the sediment that entered it. It can be assumed that 100% of the sand-sized and coarser sediment (i.e., bedload) was trapped by the reservoir.

Glysson (1977) also sampled the reservoir sediment at the thalweg of 18 of the 31 cross-sections (ranges). Glysson reported that the weighted mean dry weight density of all of the samples was 58 lbs/cu ft. Other investigators, including SDC (2007) and CDFG (2008) have recommended applying this weighted mean dry weight density to the entire 3,400 ac-ft sediment deposit for determining its total weight, from which they then estimated the unit area yield of bedload sized sediment by applying the 30% bedload assumption from Watson et al. (2003). **geomorph** reviewed both the technical basis for the 30% bedload estimate of Watson et al. (2003) and the detailed sedimentation data provided in Glysson (1977), and determined that a more watershed-specific and accurate unit area bedload yield estimate could be developed for the upper Salinas from the reservoir sedimentation data without requiring the general assumptions of Watson et al. (2003).

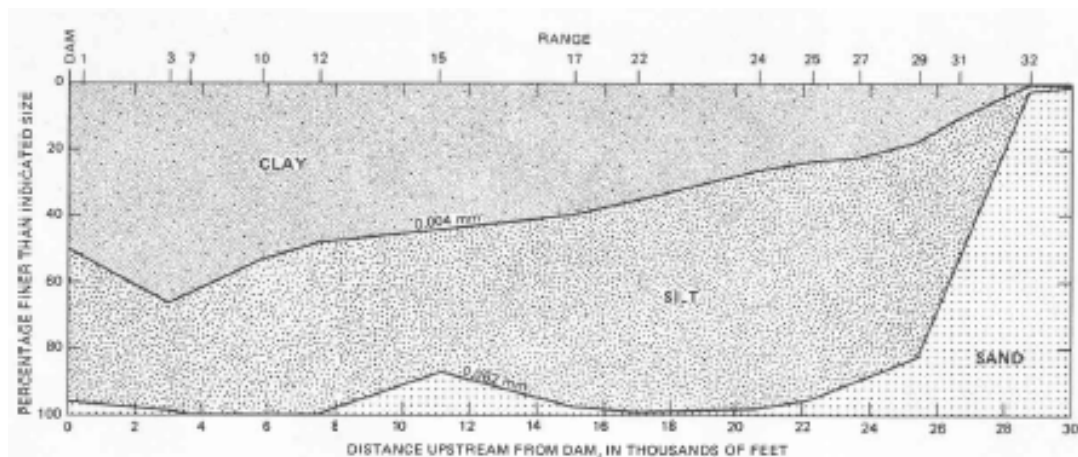


FIGURE 6.—Particle-size distribution of sediment in Santa Margarita Lake.

Figure 19. Copy of Figure 6 in Glysson (1977) showing the particle-size distribution of sediment in Santa Margarita Reservoir. The sand-sized sediment is mostly deposited in the upstream end of the reservoir.

Glysson (1977) reported the percentage (by weight) each of the 18 sediment samples taken from within the reservoir was comprised of different sized sediment classes. Table 4 and Figure 6 from Glysson (1977) are reproduced in Appendix D. From these raw data, the percentage by weight that the total 2,800-ac-ft within reservoir sediment deposit is comprised of sand-sized or coarser sediment (i.e., bedload) can be determined. Specifically, the area under the silt-sand transition curve of Figure 6 from Glysson (1977) is 14.5% of the total area (Figure 19). That is, 14.5% of the total weight of the 2,800-ac-ft

within reservoir sediment deposit is the weight of bedload material. It is a valid assumption that 100% of the total weight of the 600-ac-ft above reservoir spillway sediment deposit is bedload material because 98% or nearly 100% of the within reservoir sediment deposit nearest the upstream end of the reservoir (e.g., at Range 32) is sand-sized or coarser material. Therefore, the total weight of bedload material contained in the total 3,400-ac-ft deposit is 1.77 million tons. These data indicate then that bedload comprises 37% of the total sediment supplied by the 110-sq-mi upper Salinas River watershed. Please see Appendix E for a complete tabulation of these calculations.

When this total bedload weight is converted to total bedload volume (1.38 million CY) and divided by both the number of years in the measurement period (34) and the number of square miles draining to the reservoir (110 sq mi), the average annual bedload yield is determined to be 369.2 CY/sq mi/yr (Appendix E). Notably, while the bedload-sized sediment comprises 37% of the total weight of the reservoir sedimentation, it comprises only 25% of the total sedimentation volume. This is because waterborne clay- and silt-sized sediment deposits are substantially looser packed than sand-and-gravel materials.

geomorph submits that other investigators have erroneously applied the weighted mean dry weight density of the clay- and silt-dominated within-reservoir deposit to the entire reservoir induced sedimentation, including the sand-and-gravel dominated deposit lying within the upstream end of the reservoir and still farther upstream above the reservoir spillway elevation. More detailed investigation of the reservoir sedimentation data produces the more site-specific and accurate unit area bedload sediment supply estimate recommended by this Plan.

The 37% bedload estimate determined from the detailed reservoir sedimentation data is higher than the 30% estimate suggested by Watson et al. (2003) might apply for the entire western side of the upper Salinas watershed. The study by Watson et al. (2003) focused on suspended sediment transport during non-flood flows for determining TMDL. The study made assumptions about what percent of the total sediment supply was bedload for the purposes of extending the suspended sediment transport data to compile a preliminary total sediment budget for the Salinas River. Specifically, Watson et al. (2003) cited an estimate by McGrath (1987) that approx. only 1% of the total sediment load in the depositional lower river section at the Spreckles gage is bedload. They also cited Hecht (2000) *citing* Kondolf (1982) that up to 50% of the total sediment load generated in the northern Santa Lucias is bedload material. Inman and Jenkins (1999) estimated 10-73% of total load was bedload for an array of Southern California streams. Watson et al. (2003) appeared to settle most firmly on information from studies on the Carmel River (e.g., Kondolf 1982, Hampson 1997). Based on 5 years of sediment transport data collection, Hampson (1997) found approx. 27% of total sediment load on the Carmel River was bedload. Without more specific expressed rationale than these, Watson et al. (2003:35) suggested that 30% be used to estimate bedload supply as a percentage of total supply for the "partly granitic" watershed areas (i.e., on the western side of the watershed), and 20% be used for "other areas" (i.e., on the eastern side of the watershed). To wit, if Watson et al. (2003) had obtained and reviewed the detailed sediment data in Glysson (2007) as reviewed above, they would have been able to quote a site-specific bedload percentage for at least one area in the upper Salinas watershed; the data point may have resulted in their using different assumptions for compiling their preliminary sediment budget.

geomorph deems 369.2 CY/sq mi/yr to be the 'best available information' unit area bedload sediment yield for the upper Salinas River watershed area. This unit area yield value can be multiplied by the drainage area (in sq mi) tributary to any individual

geomorphic subreach or instream mine site to determine the natural annual average bedload supply there (e.g., see Table 2).

The recommended 'best available information' unit area bedload sediment yield (369 CY/sq mi/yr) is approx. 36% of the average of the high and low curve adjusted unit area bedload sediment yield calculated by Balance (2008) for the Paso Robles vicinity (1,035 CY/sq mi/yr) (Appendix E). **geomorph** deems it conservatively low and thus suitable for area-wide planning for sustainable development of the sand-and-gravel resources of the upper Salinas River in San Luis Obispo County. The recommend area-wide adaptive management type monitoring plan described in Section 6 of this Plan discussed how future improved monitoring can be used to collect site-specific data that will supplant this 'best available information' yield.

Potential adjustments to the unit area bedload sediment yield value to reflect variable watershed conditions

Adjustments can potentially be made to the 'best available information' unit area yield value in applying it to different portions of the tributary watershed area to account for differences in geology, soils, vegetative land cover, land use, and hydrology – correlated factors influencing sediment yield in a complex way. Adjustments might also be made either to the unit sediment yield or to individual subreach sediment budgets to account for reaches with accelerated bed downcutting or bank erosion, or any semi-permanent sediment storage areas (aggrading channels and floodplains, alluvial fans, etc.) identified by field observations, historical analysis, or air photo interpretation.

SDC (2007) compiled geology, vegetative cover, land use, slope, and average annual rainfall map data for the upper Salinas River watershed and used these data to compare conditions influencing sediment runoff within the 112-sq-mi upper watershed area tributary to Santa Margarita Reservoir with conditions in the larger approx. 1,617-sq-mi area tributary to the proposed Pankey Site. Figure 20 shows generalized geology for the watershed area compiled by SDC (2007). The 112-sq-mi upper watershed area is underlain primarily by consolidated marine sedimentary rocks (green) with lesser amounts of crystalline granitic rock (gray). The western portion of the larger watershed area is also underlain by consolidated and crystalline rocks, but the central and eastern areas are covered with younger unconsolidated sedimentary rock (tan) – primarily the Paso Robles Formation. Air photo and topographic map investigations show that the Paso Robles Formation is moderately to steeply sloped and deeply dissected, and the mainstem upper Salinas River, Estrella River, and Huerhuero Creek abut the formation in places.

Cachuma and Gibraltar Reservoirs on the upper Santa Ynez River watershed receive drainage from a total 417-sq-mi area of similar geology and relief as the middle and downstream portions of the upper Salinas River, including deeply dissected mantles of the same Paso Robles Formation. According to repeat reservoir bathymetry survey data, the reservoirs have accumulated a total of 27,712 ac-ft of sediment in the 53 years from 1955 to 2008. This amounts to 1.25 ac-ft/sq mi/yr for the Santa Ynez River reservoirs, about 38% more than the 0.91 ac-ft/sq mi/yr accumulated in Santa Margarita Reservoir (Glysson 1977).

geomorph submits that among other things the broad mantle of deeply dissected unconsolidated Paso Robles Formation in the middle and downstream portions of the upper Salinas River watershed suggests that the unit area sediment yield determined from upper watershed reservoir sedimentation may be lower not higher than the watershed average.

All of the previous investigators except CDFG have concluded similarly that the unit area sediment yield is higher at watershed positions downstream from Santa Margarita Reservoir. SDC (2007) concluded that the watershed geology and other factors suggest there may be greater unit area sediment yields from the downstream watershed areas. As discussed in more detail below (e.g., see Figure 22) Watson et al. (2003) published measurements and regression fits showing that the unit area sediment yield increases in the downstream direction and is greater, for example, in the vicinity of Paso Robles (390 sq mi) than it is in the vicinity of Salinas Dam (112 sq mi). Balance (2008) estimated unit area bedload sediment yield at Paso Robles to be approx. 2.8 times the estimate based on Santa Margarita Reservoir sedimentation data.

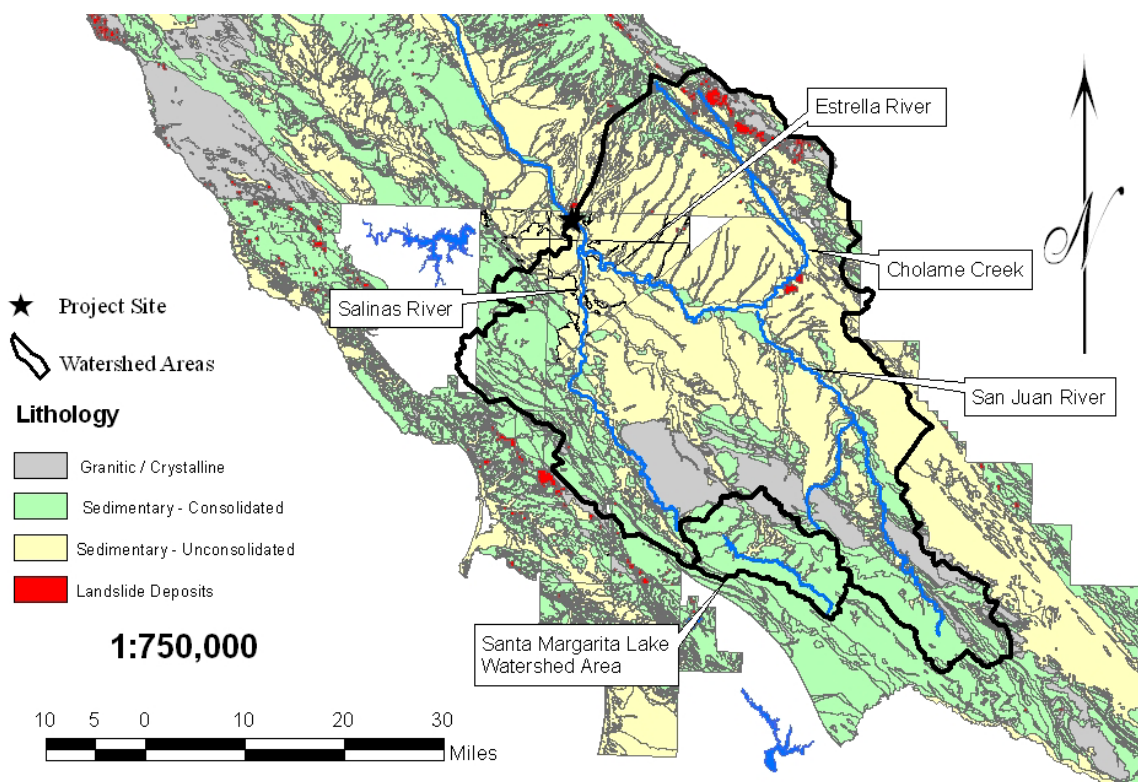


Figure 20. Distribution of geologic types in the 1,617-sq-mi upper Salinas River watershed area tributary to the proposed Pankey Sand and Gravel Mine Site and within the 112-sq-mi upper watershed area tributary to Santa Margarita Reservoir (adapted from SDC 2007). Note that the upstream most geomorphic subreaches of the mainstem upper Salinas River receive sediment from granitic and consolidated sedimentary rock sources and the lower subreaches also drain areas underlain chiefly by unconsolidated sedimentary rock, primarily of the Paso Robles Formation. Landslide deposits are concentrated along the San Andreas Fault Zone in the upper Cholame Creek watershed, tributary to Estrella River.

Other physical watershed attributes mapped and quantified by SDC (2007) appear to have an overall counteracting or balancing effect on sediment yield differences. For example, approx. 39% of the 112-sq-mi upper watershed area is sloped greater than 30%, while only 27% of the 1,515-sq-mi remainder watershed area is sloped greater than 30%. The larger percentage of steep slopes in the smaller upper watershed area suggests that the unit area sediment yields developed for the upper watershed area might be higher than for other portion of the larger watershed. Still, the steep slopes in the upper watershed area are

underlain by consolidated and crystalline rocks. Although steep slopes make up a lower percentage of the remainder of the larger watershed, a majority of the steep sloped areas are in the unconsolidated and deeply dissected Paso Robles Formation.

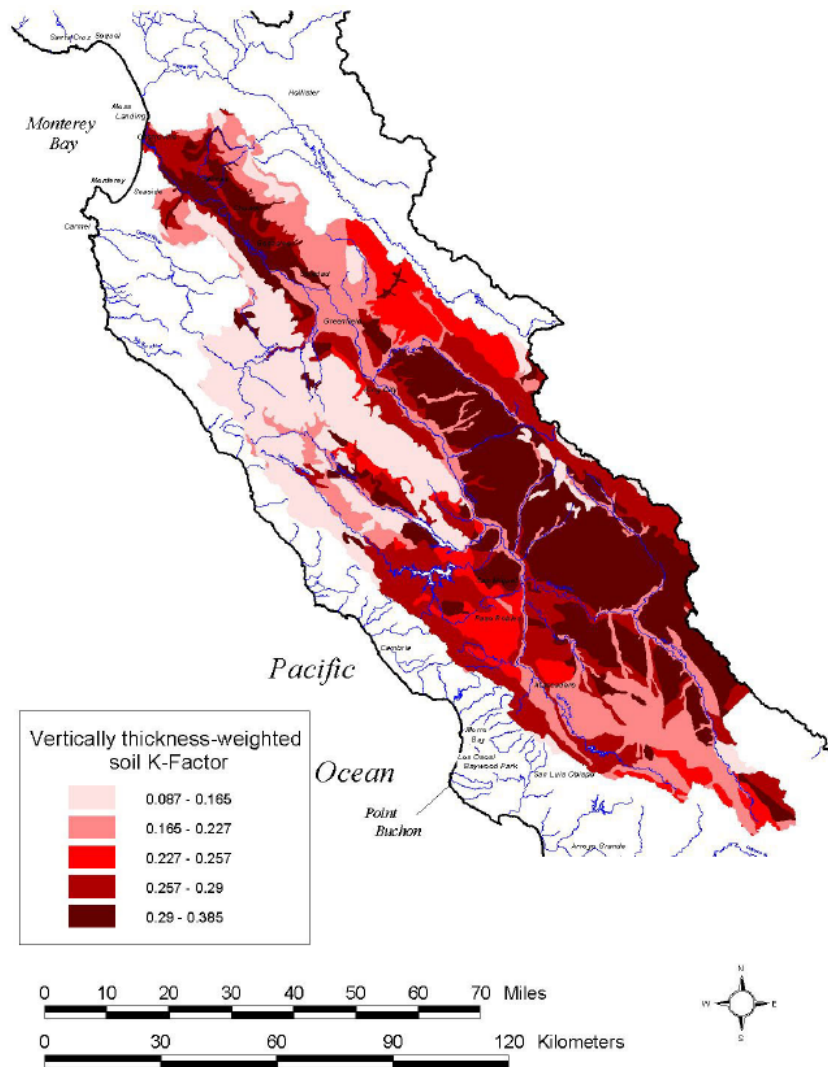


Figure 21. Distribution of soil erodibility factor, K, for the entire Salinas River watershed from the STATSGO database as compiled by Mark Angelo, CCRWQCB and reproduced from Watson et al. (2003).

For example, Watson et al. (2003) reproduced GIS analyses of soil erodibility factor and slope for the entire Salinas River watershed derived from the STATSGO database compiled by Mark Angelo of the CCRWQCB. Figure 2.3 of their report (Figure 21) shows the soil erodibility factor, K, is generally greater in the middle and downstream portions of the upper Salinas River watershed area than it is upstream from Santa Margarita Reservoir. Comparison between Figure 20 and Figure 21 shows that the highest erodibility factors overlap with the distribution of unconsolidated sedimentary deposits (primarily Paso Robles Formation).

Only 6% of the smaller upper watershed area is covered in grassland, while 54% of the remainder of the larger watershed is. Other vegetation cover types (evergreen forested, oak woodland savannah, chaparral, etc.) were similar in terms of percent of area covered. The significantly lower percentage of grassland cover in the smaller upper watershed suggests that the unit area sediment yield determined from upper watershed reservoir sedimentation may be lower not higher than the watershed average. For example, Gabet and Dunne (2003) found from a 5-year field-based study of a watershed in the Santa Ynez River watershed that grassland-covered areas of the Paso Robles Formation produced 38% more sediment discharge than sage-covered areas, and that sediment yield from these areas was driven more by slope-driven biogenic soil creep than by precipitation.

The smaller upper watershed area receives more rainfall than the remainder of the larger watershed area, but not significantly more. The average annual rainfall in the 112-sq-mi area tributary to the reservoir is 18.3 in, and the average for the 1,515-sq-mi remainder area is 15.6 in.

Overall, for the upper Salinas River watershed, as for most watershed sediment budget analyses, there does not exist an obvious technical basis for determining if and how much to adjust the unit area sediment yield value developed from the 112-sq-mi upper watershed area in applying it to other portions of the watershed area. In general, **geomorph** submits that the unit area sediment yield value should not be adjusted unless reliable data are located or otherwise a majority of experts deem it necessary to substantially improve the reliability of the resulting annual average sediment yield estimate at watershed positions of planning importance, and in a manner that helps explain found field conditions.

Drainage Area Ratio. Another method of analytically adjusting the unit area sediment yield in applying it for estimating sediment supply at different watershed positions is to apply a general unit area sediment yield-drainage area relation. It is typical, for example, for smaller upper watershed areas to yield more sediment per unit tributary watershed area than larger watershed areas measured at farther downstream watershed positions. This is because steeper areas high in watersheds generally have more precipitation and yield more sediment per square mile watershed area than more gradually sloped areas lower in watersheds. If a substantial portion of the sediment yield is stored in actively aggrading beds and floodplains along the mainstem and tributary streams, it reduces the net sediment yield farther downstream in the watershed; the percentage of sediment yield stored in floodplains typically increases in the downstream direction as the valley and river slope decrease. For these reasons, unit area sediment yields are typically higher at upper watershed positions than at lower watershed positions. Not all watersheds follow this general model. In some watersheds there are higher sediment producing subwatersheds discharging at lower watershed positions. Watersheds with actively downcutting mainstem streams do not store sediment in floodplains but instead can produce additional sediment yield at lower watershed positions by erosion of sediment stored in formerly active floodplains and terraces. There are too few data for reliably assessing the unit area sediment yield-drainage area relationship on the upper Salinas River. Watson et al. (2003:19) evaluated all of the available sediment transport data for the watershed and concluded that unit area sediment yield does not decrease in the downstream direction:

“...[Salinas River] data sets contradict (for watersheds smaller than 10,000 km²) the simplistic common statement that sediment per unit area should decrease with increasing watershed area.”

Indeed, air photo and topographic map review suggests there are few actively increasing long-term sediment stores anywhere in the upper Salinas River watershed. The watershed

is characterized by relatively narrow steeply sloped valleys tightly flanked by relatively steeply sloped deeply dissected uplands. Almost all of the valley fill material is older alluvium stored at depth below and in terraces high above the modern active channel. The modern active channel and floodplain complexes are much narrower and inset several to tens of feet lower within the much more massive older alluvial fill. Historical geomorphic analysis of the Pankey mine site vicinity near San Miguel (see Section 3) indicates that floodplain surfaces are not fine-grained depositional units but instead coarse-grained bars which are actively migrating bar units during very large floods. Scant historical bed elevation data suggest that the upper Salinas River low flow channel bed elevations have decreased at least about two feet during and/or since the 1969 flood within and over tens of miles upstream from the Site. A comparable amount of bed aggradation may have occurred downstream from the Nacimiento River confluence about 11 miles downstream from the Site. The recent trends affecting sediment delivery to the Site appear strongly toward reduced floodplain sediment storage and increased bed and bank erosion of sediment stored in older floodplain units and terraces. This is not to say that the mainstem river and its tributaries do not have the potential to *temporarily* store large volumes of sediment. The hydrology is such that for several years sediment delivery and transport are only partially activated and sediment can accumulate on the bed until a moderate or large flood sweeps it completely through the reach. Referring to the interruption of sediment transport by streambed percolation, Watson et al. (2003:31) stated:

“...prolonged drought in the main-stem can lead to the accumulation of sediment over several years as headwater storms deposit their sediment load into the dry valley floor streambed.”

The apparent trend away from semi-permanent sediment storage along the river corridor may be partly caused by and at least reinforced by land use impacts upstream from the Site, including reservoir construction, urbanization, shallow groundwater withdrawals, and instream sand and gravel mining. Construction of Santa Margarita Reservoir reduced bedload sediment supply to the upper Salinas River downstream from the dam. It is typical for impoundments to result in bed and bank erosion extending for tens of miles downstream from the dam. Downstream bed and bank erosion typically slows within the first two decades after dam construction. The direct effects of Santa Margarita Reservoir have probably reduced to an insignificant level. Until recently, there has been relatively little urbanization in the upper Salinas River watershed upstream from the Site. Urbanization has probably increased peak flows on the mainstem upper Salinas River by a marginal amount. Instream mining extracts sand and gravel directly from the channel of the upper Salinas River. Past and future instream mining reinforces trends toward reduced in-channel sediment storage upstream from the Site.

As discussed elsewhere in this Plan, Balance (2008) prepared unit area sediment yield estimates by applying high and low envelope sediment transport curves to the Salinas River at Paso Robles gage data. Recall that the resulting unit area sediment yield as adjusted in by this study (Appendix F) was about 2.8 times greater than the estimate resulting from the Santa Margarita Reservoir sedimentation study. Balance (2008) applied the estimated unit area sediment yield uniformly to watershed positions along a reach of the upper Salinas River, from nine miles upstream from Paso Robles to about nine miles downstream from Paso Robles. This 18-mile-long study reach included the confluence of Huerhuero Creek watershed and extended down to the Estrella River confluence about 1.25 miles upstream from the Pankey Site.

Considering all the available information and previous work by other investigators, it does not appear justified to apply a general unit area sediment yield-drainage area relation to

analytically adjust the unit area sediment yield in applying it for estimating sediment supply at different watershed positions. Watson et al. (2003) observed that the unit area sediment yield increases in the downstream direction. Balance (2008) used a drainage area ratio of 1.0 to the 18-mile long reach upstream from the proposed Weyrick mine site. **geomorph** recommends drainage area ratio of 1.0 (unitless) be used for estimating the average annual sediment replenishment rate at locations along the 30.22-mile long mainstem upper Salinas River, including the Pankey Mine Site.

Estrella River watershed unit area sediment yield. The Estrella River discharges to the upper Salinas River at river mile 113.50, about 0.9 mi upstream from the San Miguel Bridge. At the confluence, the total upper Salinas River watershed area is approx. 602 sq mi and the total Estrella River watershed area is approx. 949 sq mi. The upstream end of Reach S-1 is located immediately upstream from the confluence. The Estrella River watershed makes up 61% of the watershed area tributary to the upstream end of Reach S-1. Therefore, whether the 'best available information' unit area bedload sediment yield (369 CY/sq mi/yr), or an adjusted value, is applied to the Estrella River strongly affects the estimated bedload sediment supply to Reach S-1 and the Pankey Site.

Recall that the geology, land use, slope, vegetation cover, and precipitation data reviewed above suggested that the presumed differences in unit area sediment yield were both positive and negative across the watershed and therefore generally self-balancing, such that in the absence of specific data, unit area sediment yields may be assumed approx. the same for the western, central, and eastern portions of the upper Salinas River watershed area. These mapped and quantified watershed attribute data did not provide a reliable technical basis for adjusting the unit area bedload sediment yield value up or down in applying it to the Estrella River watershed area.

Yet, the substantial differences in hydrology (e.g., difference in total annual runoff per unit watershed area) warrant considering adjusting down the unit area yield value in applying it to the Estrella. For one, CDFG has suggested that the unit area bedload sediment yield for the Estrella River watershed area is exactly two-thirds of the yield determined from reservoir sedimentation data of Glysson (1977). This assumption is based on the suggestion by Watson et al. (2003) that the percentage of total sediment yield that is bedload-sized material is about 30% for "partly granitic" watershed areas (i.e., western tributaries) and about 20% for "other areas" (i.e., eastern tributaries). As discussed above, Watson et al. (2003) appeared to select 30% as an approximation based on the 27% bedload determined for the Carmel River by Hampson (1997), and selected 20% based not on any sediment transport data but by professional judgment apparently as it is a reasonable reduction from 30%. As shown above, the upper Salinas River watershed produces 37% bedload-sized sediment, not 30%. Furthermore, Watson et al. (2003:38) estimated that east side tributaries to the Salinas produced more sediment yield than west side tributaries in some instances due to proximity to the San Andreas Fault Zone:

"The western (Santa Lucia) ranges of the watershed are estimated to contribute a slightly higher load than the eastern ranges. However, there is evidence for very high loads from isolated eastern range localities."

Figure 20 shows that the Cholame Creek tributary to the Estrella River captures runoff from a substantial length of the San Andreas Fault Zone where the geology reflects intense shearing and landslide susceptibility. The Upper Salinas-Las Tablas Resource Conservation District (US-LT RCD 2004) conducted a reconnaissance level geomorphic study of the 2,000-sq mi upper Salinas River watershed lying upstream from the Nacimiento-Salinas confluence, including field surveys and basic historical geomorphic analysis of Cholame

Creek and Estrella River. US-LT RCD (2004) documented primarily unvegetated channel banks and recent channel bed incision along Cholame Creek, and concluded that the 1,000-sq mi Estrella River watershed draining the more arid eastern half of the upper Salinas River watershed may be responsible in general for an “excess” sediment supply on the mainstem Salinas River. Indeed, air photos show that the upper Salinas River active channel-floodplain complex is wider and more strongly braided immediately downstream from Estrella River than it is upstream from the confluence. This apparent “sedimentation zone” effect (see Section 3.3) diminishes downstream from the proposed Pankey Mine Site, even despite sediment contributions from the aggrading Vineyard and Big Sandy tributary creeks, as the valley slope and degree of valley confinement increase toward the narrower middle section of the Salinas River beginning near the County line.

Regarding the sediment yield effect of the San Andreas Fault Zone, Watson et al. (2003) observed:

“The San Andreas Fault parallels the eastern watershed boundary, and the entire Salinas watershed located west of the San Andreas Fault is continuing a northward migration of between 3 and 6 cm/yr. This ancient and modern fault activity continues to produce a broad zone of folded, fractured, and crumbled crust. As this masticated crust is uplifted to the surface, it is among the most easily eroded sediment sources in the Salinas basin; likewise it is very prone to slope failure adding yet more natural background sediment to the Salinas River system.”

If the high erodibility of Paso Robles Formation and the San Andreas Fault effects are reasons why the unit area sediment yield of the Estrella River watershed is at least comparable to that of the upper Salinas River watershed area, then it would help explain why rather surprisingly to Watson et al. (2003:161), they found the unit area sediment yield increased in the downstream direction for the Salinas River:

“...sediment yield per unit area increases with increasing sub-watershed area to about 200-500 km², and then levels off between 1,000 and 10,000 km² (Figure 6.16)...”

Figure 6.16 (Figure 22) shows the general increasing trend Watson et al. (2003) found in unit area sediment yield with increasing drainage area within the Salinas River watershed. Unit area sediment yield increases steadily to a peak near 200-500 km² (80-200 sq mi) – in the vicinity of Templeton. Inspection of individual data forming this relation reveals that Watson et al. (2003) measured sediment yields on tributary Santa Rita Creek tributary to Paso Robles Creek tributary to Salinas River near Templeton that were approx. 10 times greater than they measured downstream at the Paso Robles gage (390 sq mi). Indeed Las Tablas-upper Salinas RCD highlighted rapid severe channel incision on Paso Robles Creek in their geomorphic reconnaissance report (LT-USR RCD 2004). Figure 22 shows that unit area yields decrease to a local minimum at near 1,000 km² (390 sq mi) – at the USGS stream gage located at the 13th Street Bridge in Paso Robles. Unit area yields then increase again with distance downstream from Paso Robles, as would include discharges from Huerhuero Creek and Estrella River.

Overall, despite this and other academic exercises completed to date, **geomorph** finds there are no sediment transport data or geomorphic evidence in air photos or found field conditions that the Estrella River discharges less bedload sediment per unit area than does the upper Salinas River. **geomorph** submits that in the absence of data or found field conditions suggesting that the Estrella River delivers substantially less bedload sediment per unit drainage area than does the upper Salinas River, it appears prudent in this Plan to apply the same unit area sediment yields to the entire upper Salinas River watershed including the Estrella and upper Salinas sub-watershed areas.

The S-1 Monitoring Plan recommended as a required part of the proposed Pankey Sand and Gravel Mining Project in this Plan would include expert upper Salinas River bed elevation monitoring near the upper Salinas-Estrella River confluence (see Section 6.5). Implementing the S-1 Monitoring Plan would provide new field-based expert analysis of actual Estrella River sediment yield effects over time on the Reach S-1. Implementing similar monitoring plans on the other individual geomorphic subreaches as recommended by the outlined area-wide adaptive management type monitoring plan might also include quantitative monitoring of sediment storage dynamics on the Lower Estrella River. This way, future iterations of the area-wide adaptive management type monitoring plan outlined in this Plan may apply field evidence or other technical rationale in adjusting the Estrella River sediment yield up or down from the Salinas River value for watershed-scale sediment budgeting purposes.

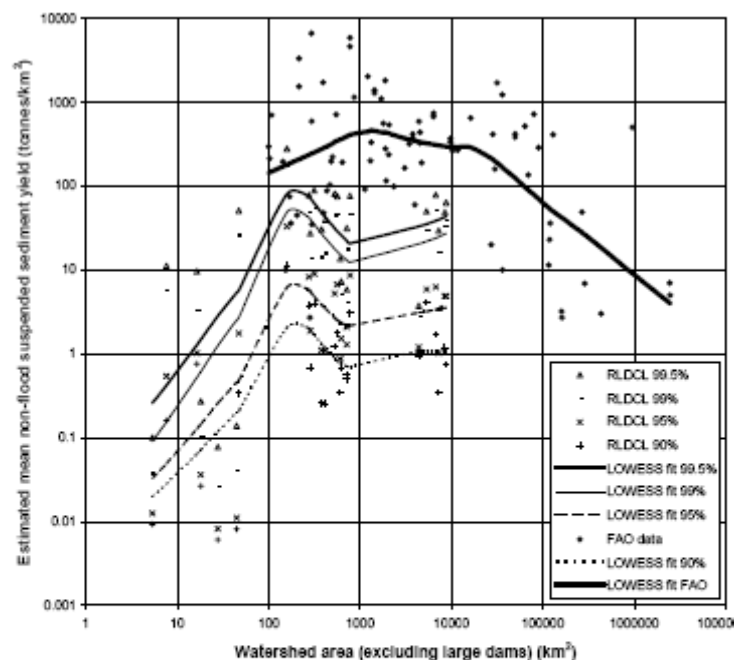


Figure 6.16. The balance of sediment yield amongst large and small streams, from the 90th percentile increasing to the 99.5th percentile. FAO Global Sediment Yield Database: watersheds with 300–700 mm annual rainfall (i.e. those climatically most similar to the Salinas Watershed). LOWESS smooth applied to data with Tension 0.5. Note that the FAO data represent total sediment load, whereas the RLDCL data represent non-flood suspended load – hence the overall difference in magnitude.

Figure 22. Figure 6.16 reproduced from Watson et al. (2003) showing the general increasing trend in unit area sediment yield with increasing drainage area within the Salinas River watershed. Unit area sediment yield increases to a peak near 200-500 km² (80-200 sq mi), then decreases to a local minimum at near 1,000 km² (390 sq mi), then increases again with distance downstream.

Estimated annual average natural bedload sediment supply to individual subreaches of the mainstem upper Salinas River

Table 2 summarizes the estimated annual average natural bedload sediment supply to the downstream ends of individual subreaches of the 30.22-mi-long mainstem upper Salinas River study reach and other locations relevant to the proposed Pankey Project. The effects of existing and proposed new instream sand and gravel mines on the bedload sediment budgets of the individual geomorphic subreaches are evaluated in Sections 4.4 and 6.2.

Table 2.

Estimated annual average natural bedload sediment supply to individual geomorphic subreaches of the mainstem upper Salinas River and other locations

<u>Subreach</u>		Total Drainage Area Tributary to Downstream End (sq mi)	Drainage Area less Santa Margarita Reservoir (sq mi)	Unit Area Bedload Sediment Yield (CY/sq mi/yr)	Estimated <i>Natural</i> Annual Average Bedload Supply (CY/yr)
Reach S-5	Upper Salinas River between approx. 9 mi upstream from Paso Robles to approx. 5 mi upstream from Atascadero	253	141	369.2	51,980
Reach S-4	Upper Salinas River between approx. 3 mi upstream to approx. 9 mi upstream from Paso Robles	367	255	369.2	94,198
Reach S-3	Upper Salinas River between Huerhuero Creek and approx. 3 mi upstream from Paso Robles	407	295	369.2	109,012
Reach S-2	Upper Salinas River between Estrella River and Huerhuero Creek confluences	532	420	369.2	155,167
Reach S-1	Upper Salinas River between County Line and Estrella River confluence	1,526	1,414	369.2	522,076
<u>Other Locations</u>					
Pankey Site	Upper Salinas River between downstream property boundary and upstream property boundary	1,524	1,412	369.2	521,499
Vineyard Ck	Tributary to Upper Salinas River within proposed Pankey Site	52	52	369.2	19,318

Notes

Drainage areas reduced by 112-sq-mi area tributary to Salinas Dam to reflect nearly 100% bedload trapping by reservoir.

Drainage areas to S-2 and S-1 and Pankey Site reduced by 69.3 sq mi area tributary to #52 Creston existing instream mine.

Drainage areas to S-1 and Pankey Site further reduced by 23.1 sq mi area tributary to #27 Navajo Creek existing instream mine.

Drainage areas determined by USGS gage watershed areas and 1:100,000 scale USGS map delineation and planimetry as follows:

1. Drainage area at USGS gage "Salinas River at Paso Robles" at 13th Street Bridge (RM 122.19) is 390 sq mi (USGS).
2. Tributary drainage area to S-3 above gage is 22.9 sq mi; Thus drainage area tributary to downstream end of S-4 is 367.1 sq mi.
3. Tributary drainage area to S-4 is 114.3 sq mi; Thus drainage area tributary to downstream end of S-5 is 252.8 sq mi.
4. Check: All tributary area to S-5 from below Salinas Dam is 139.4 sq mi; Thus drainage to Salinas Dam is 113.4 sq mi (112 sq mi).
5. Non-Huerhuero Ck drainage area tributary to S-3 below gage is 17.2 sq mi; Thus area at downstream end of S-3 is 407.2 sq mi.

6. Huerhuero Ck d.a. is 158.1 sq mi and other d.a. to S-2 is 36.2 sq mi; Thus total drainage area at d/s end of S-2 is 601.5 sq mi.
7. Drainage area to d/s end of S-2 reduced by drainage area tributary to #52 Creston mine (69.3 sq mi), from 601.5 to 532.2 sq mi.
8. Drainage area at USGS gage "Estrella River nr Estrella" 0.2 mi downstream from Ranchito Canyon tributary is 922 sq mi (USGS).
9. Tributary drainage area to Estrella River below gage is 26.8 sq mi; Thus total Estrella River drainage area is 948.8 sq mi.
10. Tributary drainage area to S-1 above Pankey Site is 2.9 sq mi.
11. Vineyard Creek tributary to Pankey Site is 52.3 sq mi; Other local tributary drainage area to Site is 11.2 sq mi; Total is 63.5 sq mi.
12. Tributary drainage area to S-1 downstream from Pankey Site and upstream from County Line is 1.6 sq mi.
13. Total non-Estrella drainage area to S-1 is 68.0 sq mi; Thus total drainage area at downstream end of S-1 is 1,549.1 sq mi.
14. Drainage area to d/s end of S-1 reduced by drainage area tributary to #27 Navajo Ck (23.1 sq mi), from 1,549.1 to 1,526.0 sq mi.
15. Total tributary drainage area to downstream end Pankey Site is S-1 total less 1.6 sq mi, or 1,524.4 sq mi.
16. All Upper Salinas River tributary drainage areas reduced by 112 sq mi drainage area tributary to Salinas Dam (Glysson 1977).

4.4 Existing Conditions mining-reduced sediment supplies and sediment bypass for individual subreaches of the mainstem upper Salinas River

According to the complete information obtained from County, City, and OMR document archives and digital databases, there are thirteen existing permitted aggregate mines and four proposed new mines within San Luis Obispo County (Table 3). Eleven of the thirteen existing permitted mines are instream mines (#21 North River Road Pit and #29 County North River are off-channel mines). One of the eleven permitted instream mines is closed (#15 Miller). Two of the remaining ten active existing permitted instream mines are not included in the Plan area because they are on tributaries that are too far from mainstem to impact the upper Salinas River sediment budget. One (#27 Navajo Creek) is on Navajo Creek, a tributary to San Juan Creek more than 35 river miles from the upper Salinas River. The other (#52 Creston) is on Huerhuero Creek near Creston, about 15 river miles from the upper Salinas River. There are seven active permitted instream mines on the mainstem upper Salinas River and one newly permitted instream mine (Viborg-Estrella) located on the Estrella River about 5.5 river miles upstream from the mainstem.

Seven of the existing permitted instream mines and three of the proposed new instream mines are on the mainstem upper Salinas River (Figure 23). Six of the seven existing mainstem instream mines are within Reach S-4 and Reach S-3. There is one existing instream mine (#42 Borzini South) in Reach S-5. There are no existing instream mines in Reach S-2 and Reach S-1. However, when the eighth existing permitted instream mine (the newly permitted Viborg-Estrella) begins operating, it will have an impact on the sediment budgets of the lower 5.5-mile long reach of the Estrella River and Reach S-1 of the upper Salinas. This Plan therefore considers Viborg-Estrella mine within Reach S-1 for sediment budgeting purposes. The combined total annual permitted maximum extraction rate for the eight existing permitted instream mines in the Plan area is 265,000 CY/yr.

Three of the four proposed new instream mines would be on the mainstem river in Reach S-2 (two) and Reach S-1 (one). The fourth of four proposed new instream mines is on San Marcos Creek, tributary to Reach S-2. This relatively small operation is proposed for dredging existing instream dammed stock ponds and is generally not expected to exert any effects on the upper Salinas River sediment budget. The proposed Pehl and Weyrick projects would extract a combined total of 120,000 CY/yr from Reach S-2 (Table 3, Figure 23). The proposed Pankey Sand and Gravel Mine Project on Reach S-1 is both a mainstem and tributary mine site. It would extract as much as 96,000 CY/yr total from the mainstem upper Salinas River from two extraction areas upstream and downstream from the Vineyard Creek tributary confluence. It would also extract as much as 9,500 CY/yr from the bed of

Vineyard Creek upstream from the upper Salinas River. The proposed new instream mines would extract an annual maximum permitted amount of 225,500 CY/yr from the mainstem river. Considered together, the permitted and proposed instream mines in the Plan area would extract a total annual maximum of 490,500 CY/yr (Table 3).

Table 3.

Existing permitted and proposed new aggregate mines in San Luis Obispo County
(Sources: San Luis Obispo County, City of Paso Robles, State Office of Mine Reclamation)

Watershed Location	ID# or Status	Mine Name(s)	River Mile (RM)	Instream?	Ann Max Extraction (CY/yr)	County or City	OMR
Reach S-5	#42	Sycamore Road Pit, Borzini South	133.90	Yes	50,000		Active
<i>Reach S-5 instream subtotal:</i>					<i>50,000</i>		
Reach S-4	#53	Smith Pit	129.00	Yes	25,000		Active
Reach S-4	#34	Templeton/Ormonde, Borzini North	128.13	Yes	50,000		Active
Reach S-4	#15	Miller, Miller River	127.40	Yes	20,000	Closed	Active
Reach S-4	#48	Nesbitt	126.00	Yes	20,000		Active
<i>Reach S-4 instream subtotal:</i>					<i>95,000</i>		
Reach S-3	#30	Salinas River Borrow Pit	122.36	Yes	5,000	Idle	Idle
Reach S-3	#40	Lone Oak Rock & Sand	124.50	Yes	20,000	Active	Active
Reach S-3	#23	North River Rd Borrow Pit	121.85	Yes	50,000	Idle	Closed
off-channel	#29	County North River Road Mine	na	No	2,500		Closed
<i>Reach S-3 instream subtotal:</i>					<i>75,000</i>		
Huerhuero Ck	#52	Creston	na	Yes	60,000		Active
<i>Huerhuero Ck instream subtotal:</i>					<i>60,000</i>		
Reach S-2	Proposed	Pehl	117.52	Yes	80,000		
Reach S-2	Proposed	Weyrick	116.45	Yes	40,000		
off-channel	#21	North River Road Pit	na	No	10,000		Active
San Marcos Ck	Proposed	San Marcos Ck	na	Yes	nd		
<i>Reach S-2 instream subtotal:</i>					<i>120,000</i>		
Estrella River	Pending	Viborg-Estrella	na	Yes	45,000		
Navajo Ck	#27	Navajo Rock & Block, Navajo Creek	na	Yes	40,000		Active
<i>Estrella River instream subtotal:</i>					<i>85,000</i>		
Reach S-1	Proposed	Pankey-Salinas	112.04	Yes	96,000		
Vineyard Ck	Proposed	Pankey-Vineyard	na	Yes	9,500		
<i>Reach S-1 instream subtotal:</i>					<i>105,500</i>		
<i>Area-Wide Plan instream total:</i>					<i>490,500</i>		
<i>San Luis Obispo County instream total:</i>					<i>590,500</i>		

Notes

nd – not determined.

na – not applicable.

Grey denotes closed, off-channel, or mine deemed far enough from mainstem to have negligible impact.

Closed, off-channel, or distant mines not included in subreach subtotals and area-wide plan total.

Green denotes proposed new instream mines expected to impact sediment budget depending on approval.

Annual maximum extraction rate for Templeton/Ormonde (#34) is 100,000 CY/yr in County provided information, but 50,000 CY/yr in most recent (2006) CDFG SAA permit, assumed 50,000 CY/yr.

Miller River (#15) is closed but is shown active according to OMR database; assumed closed.

North River Road Borrow Pit (#23) is closed according to OMR but idle according to City; assumed idle.

Proposed Pankey mine shown as two line items to reflect mainstem and tributary extraction areas at site.

Appendix H tabulates additional specific mine location information and Appendix C contains air photo maps showing the relative proximity of the mine sites and recent conditions at the individual existing and proposed mine sites.

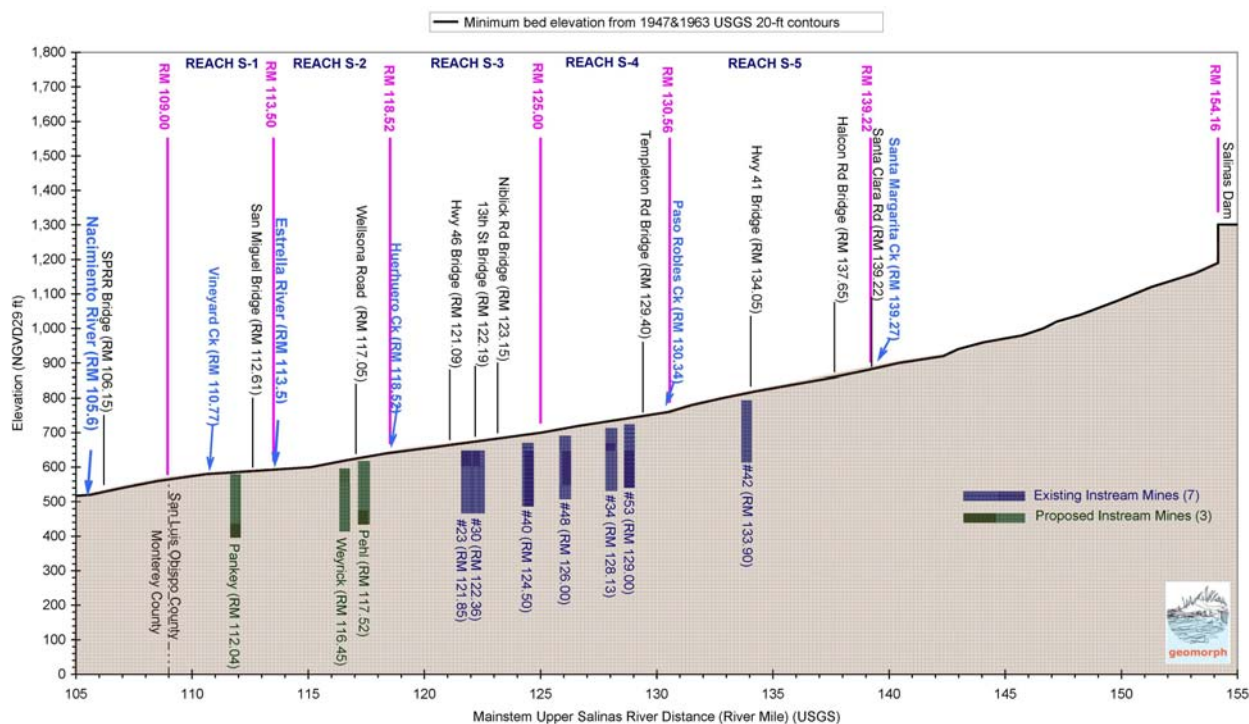


Figure 23. Longitudinal bed elevation profile of the mainstem upper Salinas River from Salinas Dam to Nacimiento River confluence showing locations of existing and proposed instream sand and gravel mines, tributary confluences, and road crossings within each of the five geomorphic subreaches designated by this study. Locations are denoted in river miles (RM) according to USGS stationing. Longitudinal bed elevation profile data from most recent USGS quadrangle maps containing combination of 1947 and 1963 20-ft contour data. For better resolution, please see this figure reproduced in a larger format in Appendix G.

There are considerable uncertainties in estimating the amount that the existing permitted and proposed new instream mines would reduce bedload sediment supplies to the individual geomorphic subreaches. First, actual extraction from individual instream mines is less than the annual permitted maximum extraction, but the difference cannot be precisely determined because the actual extraction data are proprietary. In many years actual annual extraction does not reach the maximum permitted amount because market demand or recent replenishment is low. A review of the available planning and permit documents for the upper Salinas River mainstem instream mines shows that mining is also commonly delayed by permitting and presence of shallow groundwater (Appendix L). Site-specific excavation permit limitations such as horizontal and vertical setbacks (redlines) should prevent economic extraction in years when the mining area elevations are near the redline elevation, such as in extended duration drought cycles.

Still, there may be sufficient data available to estimate what percentage of the total annual maximum permitted extraction is actually performed on an annual average basis. Recall that the County accessed actual combined total production data for the most recent 7-year period. Mine production amount is approx. the extracted amount less the stockpiled amount. The aggregated data for nine mines (#15, #21, #27, #29, #34, #42, #48, #52, and #53) within the County limits (not including mines #23, #30, and #40 in City jurisdiction) indicated that the recent 7-year actual production was 47% (approx. 50%) of the total annual maximum permitted extraction. A review of the available planning and permit documents and annual mine inspection reports received from the City indicates that mining from the three City jurisdiction mines for the same recent 7-year period was much less than 50% of the total annual permitted maximum. Notably, for example, #23 North River Rd Borrow Pit (50,000 CY/yr annual maximum permitted extraction) has been idle since 2002. As discussed in Section 4.1, a review of all mine permit and annual inspection report information obtained from County, City, and State offices (Appendix L) indicates that mining extraction rates are routinely limited by at least four factors in approximate order of most reported to least reported factor:

1. failure to secure necessary permits;
2. insufficient annual replenishment;
3. limited market demand; and,
4. seasonal presence of shallow groundwater.

Second, instream mines reduce the annual average bedload sediment replenishment rate at downstream locations by an amount that is somewhat less than actual extraction. That is because temporary geomorphic adjustments to instream mine excavation produce some sediment to balance the local deficit. That is, some of the sediment extracted from the budget is replaced primarily from channel bed downcutting and secondarily from related bank erosion upstream and downstream from the excavation area(s). If properly regulated, these temporary impacts of extraction from individual mines are typically local – within the mine site and extending upstream and downstream from the mine over distances typically comparable to 1-2 times length of the excavation area. For example, the Operator of #23 North River Rd Borrow Pit reported that excavation began on or about 1967 and the pit has been mined to maximum 8 ft depth. Repeat cross-section survey data at the 13th Street Bridge just approx. 500 ft upstream from the pit indicate that the average bed elevation decreased only 1-1.5 ft from 1965 to 2004.

Especially if the mine sites are closely spaced and/or extraction rates significantly exceed the actual replenishment rate for a long period of time, then channel bed elevations will not recover as quickly from temporary local impacts, both within the direct vicinity of individual mine sites and within the intervening river reaches. Such conditions lead to cumulative impacts. That is, impacts of individual mines may extend far enough upstream and downstream to overlap the impacts of neighboring mines. This way, poor system-wide management and regulation of instream mines can cause accelerated bed elevation declines which may lead to reduced groundwater storage capacity and excessive bank erosion with associated losses of riparian vegetation – effects this Plan seeks to avoid and minimize.

geomorph therefore generally recommends applying conservative assumptions in estimating the extent to which instream mines may reduce the annual average sediment supply. For example, it may also be assumed that a large flood will occur during a winter when most or all of the instream mines are excavated down to near their minimum floor elevations (redlines) at least once during the operation lifetime of the mines. Similarly, it may be best to predict potential impacts of individual instream mines assuming a large flood will occur when the excavation area(s) is(are) redlined. Such 'worst-case scenario' planning

is consistent with basic geomorphic reasoning, especially in Mediterranean climate watersheds, because one nearly worst-case scenario event is likely to occur during the permitted duration of an instream mine.

However, it may be unreasonably conservative to construct reach-scale sediment budgets assuming all of the mines remove their annual maximum permitted maximum amounts every year (i.e., 100% mining rate). First, we know for the most recent 7-year period that the mines have produced sediment at approx. 50% of the maximum permitted rate (50% mining rate). Second, the 100% mining rate assumption might produce a physically inaccurate or 'impossible' sediment budget. For example, Table 4a, Table 4b, and Table 4c show the existing conditions mining-reduced bedload sediment bypass at the downstream ends of the individual subreaches comprising the entire 30.22-mile-long study reach for each of three assumptions: 100% mining rate (Table 4a); 75% mining rate (Table 4b); and, 50% mining rate (Table 4c).

Table 4a.
Existing Conditions
Mining-Reduced Bedload Sediment Supplies and Percent Bedload Bypass
100% Mining Rate Assumption

	Natural Annual Average Bedload Supply (CY/yr)	Existing Mines Annual Maximum Permitted Extraction (CY/yr)	100% Cumulative Total Annual Maximum Permitted Extraction (CY/yr)	Cumulative Mining- Reduced Average Bedload Bypass (CY/yr)	Percent Bypassed (%)
<u>Subreach</u>					
Reach S-5	51,980	50,000	50,000	1,980	4%
Reach S-4	94,198	95,000	145,000	-50,802	-54%
Reach S-3	109,012	75,000	220,000	-110,988	-102%
Reach S-2	155,167	0	220,000	-64,833	-42%
Reach S-1	522,076	45,000	265,000	257,076	49%
<i>Subtotals:</i>		265,000	265,000		
<u>Other Locations</u>					
Pankey Site	521,499	0	265,000	256,499	49%
Vineyard Ck	19,318	0	0	19,318	100%
<i>Subtotals:</i>		0	265,000		
<i>Totals:</i>		265,000	265,000		

Notes

Viborg-Estella mine (45,000 CY/yr) included in cumulative totals for Reach S-1 and Pankey Site.

Where there are resulting bedload sediment deficits, they are shown in red for emphasis. Table 4a shows estimated mining-reduced sediment supplies and percent bypass at the downstream ends of the individual geomorphic subreaches determined by assuming all of

the eight existing instream mines extract their total annual maximum permitted amounts every year (100% mining rate). Mining-reduced sediment supplies are determined for each individual subreach by subtracting the cumulative total annual maximum permitted extraction for all mines within and upstream from the subreach from the estimated natural supply at the downstream end of the subreach. For example, the mining-reduced sediment supply to Reach S-5 is the natural supply to the reach (from Table 2, approx. 51,980 CY/yr) less the total annual maximum permitted extraction from the one existing instream mine within the reach (from Table 3, #42 Borzini South, 50,000 CY/yr). The resulting mining-reduced sediment supply to Reach S-5 is therefore 1,980 CY/yr, or about 4% of the estimated natural supply. It follows that 4% of the natural bedload sediment supply bypasses the reach on an annual average basis. Current regulatory practice seeks to achieve minimum 50% bypass for all individual instream mine sites and larger geomorphic subreaches of salmonid-bearing rivers and streams (e.g., NOAA 2004).

The existing conditions sediment supply to the next downstream subreach Reach S-4 is reduced by the cumulative total annual maximum permitted extraction from all of the existing instream mines in Reach S-5 and Reach S-4. The Reach S-3 supply is reduced by the total mining extraction from Reach S-5, Reach S-4, and Reach S-3. Etc. According to the 100% mining rate assumption, the concentration of existing instream mines in the Templeton and Paso Robles area produces very large bedload sediment deficits in Reach S-4, Reach S-3, and Reach S-2 (Table 4a). For example, the estimated deficit in Reach S-3 is (-) 110,988 CY/yr. And although there are no existing instream mines in the next downstream subreach Reach S-2, the net existing conditions bedload sediment supply to Reach S-2 is still strongly negative due the concentration of mines upstream.

Basic geomorphic reasoning suggests that an existing conditions sediment budget compiled assuming 100% mining rate is not a physically realistic one for the upper Salinas River. Consider for example the estimated (-) 110,988 CY/yr bedload supply to Reach S-3. Reach S-3 is 6.48-mi-long or 34,214-ft-long. The active low-flow channel bed averages at most 200-ft-wide. Thus, the surface area of the low-flow bed is at most 6,842,800 sq ft. Assuming the bed width does not change, the estimated (-) 110,988 CY/yr bedload deficit would require the low-flow channel bed elevation to drop at a rate of 0.44 ft/year rate (about 5.2 in/year). Such high incision rates have been documented on several California rivers, especially in the years or decade following dam closure or resulting from excessive aggregate extraction. However, no anecdotal evidence has been uncovered suggesting that the upper Salinas River bed has lowered substantially during the recent decades over which the existing instream mines have operated.

The few historical bed elevation data that exist in Reach S-3 are from bridge inspection and maintenance records for the three bridge crossings in Paso Robles. Recall that SDC (2007) compiled repeat cross-section surveys from bridge records in their Appendix B (reproduced as Appendix I to this Plan). These data show: (1) At Hwy 46 Bridge, the average bed elevation decreased about 2.5-3 ft from 1953 to 1988; (2) At 13th St Bridge, the average bed elevation decreased 1-1.5 ft from 1965 to 2004; and (3) At Niblick Rd Bridge, the average bed elevation decreased about 2.5 ft from 1981 to 1995. The highest bed incision rate from these data (-0.18 ft/yr) occurred at Niblick Rd Bridge in the 14-year-long period from 1981 to 1995. The slowest bed incision rate from these data (-0.03 ft/yr) occurred at 13th Street Bridge in the 39-year-long period from 1965 to 2004.

If as the 100% mining rate sediment deficit suggests, Reach S-3 bed had actually been lowering 0.44 ft/yr during the 39-year period from 1965 to 2004, the bed elevation at the 13th St Bridge should have decreased during that time by 17.1 ft. But we know from

repeat bridge maintenance surveys and USGS gage data (please see Section 3 for complete analysis) that the bed elevation there has decreased only about 1-1.5 ft.

It is plausible that the bed elevations are relatively stable because the negative Reach S-3 sediment budget has been balanced by heretofore ignored contributions from bank erosion from the reach. The reach is 34,214-ft-long. If the banks are assumed uniformly 10-ft-high and sloped 2(H):1(V), then the total surface area of banks in the reach is 1,532,787 sq ft (34,214*2*22.4). For the banks to make up the bedload deficit, both banks would have had to retreat at a rate of 1.9 ft/yr. Then over a 39-yr-long period the channel width would have had to increase by about 152 ft. This Plan does not compile and review a sequence of historical air photos showing Reach S-3. Section 3 of the Plan reviews a sequence of photos at the Pankey Site in Reach S-1, about 10 river miles downstream from the 13th St Bridge in Paso Robles. There it has been seen that the reach-averaged active channel width increased from 180 ft to about 360 ft after the 1969 flood, then decreased to about 160 ft in 2004. Thus, fluctuations in the channel width of approx. 100-200 ft are possible on the Salinas River, especially resulting from large floods, but in recent decades the channel width has been decreasing not increasing.

Table 4b.
Existing Conditions
Mining-Reduced Bedload Sediment Supplies and Percent Bedload Bypass
75% Mining Rate Assumption

	Natural Annual Average Bedload Supply (CY/yr)	Existing Mines Annual Maximum Permitted Extraction (CY/yr)	75% Cumulative Total Annual Maximum Permitted Extraction (CY/yr)	Cumulative Mining- Reduced Average Bedload Bypass (CY/yr)	Percent Bypassed (%)
<u>Subreach</u>					
Reach S-5	51,980	50,000	37,500	14,480	28%
Reach S-4	94,198	95,000	108,750	-14,552	-15%
Reach S-3	109,012	75,000	165,000	-55,988	-51%
Reach S-2	155,167	0	165,000	-9,833	-6%
Reach S-1	522,076	45,000	198,750	323,326	62%
Subtotals:		265,000	198,750		
<u>Other Locations</u>					
Pankey Site	521,499	0	198,750	322,749	62%
Vineyard Ck	19,318	0	0	19,318	100%
Subtotals:		0	198,750		
Totals:		265,000	198,750		

Notes

Viborg-Estella mine (45,000 CY/yr) included in cumulative totals for Reach S-1 and Pankey Site.

Alternatively, if the mining-reduced sediment supplies and percent bedload bypass are estimated assuming 75% mining rate, the Reach S-3 sediment supply is still in severe deficit of (-) 55,988 CY/yr (Table 4b). For the 75% mining rate scenario, the Reach S-3 bed elevation would have had to decrease by 8.6 ft, or its width would have had to increase by 77 ft over the past 39-year period. Again, such severe trends are not indicated by the available historical bed elevation and air photo data.

Table 4c.
Existing Conditions
Mining-Reduced Bedload Sediment Supplies and Percent Bedload Bypass
50% Mining Rate Assumption

		<i>Existing</i>	<i>50%</i>	<i>Cumulative</i>	
	Natural	Mines	Total	Mining-	
	Annual	Annual	Annual	Reduced	
	Average	Maximum	Maximum	Average	
	Bedload	Permitted	Permitted	Bedload	Percent
	Supply	Extraction	Extraction	Bypass	Bypassed
	(CY/yr)	(CY/yr)	(CY/yr)	(CY/yr)	(%)
<u>Subreach</u>					
Reach S-5	51,980	50,000	25,000	26,980	52%
Reach S-4	94,198	95,000	72,500	21,698	23%
Reach S-3	109,012	75,000	110,000	-988	-1%
Reach S-2	155,167	0	110,000	45,167	29%
Reach S-1	522,076	45,000	132,500	389,576	75%
	<i>Subtotals:</i>	<i>265,000</i>	<i>132,500</i>		
<u>Other Locations</u>					
Pankey Site	521,499	0	132,500	388,999	75%
Vineyard Ck	19,318	0	0	19,318	100%
	<i>Subtotals:</i>	<i>0</i>	<i>132,500</i>		
	<i>Totals:</i>	<i>265,000</i>	<i>132,500</i>		

Notes

Viborg-Estella mine (45,000 CY/yr) included in cumulative totals for Reach S-1 and Pankey Site.

Recall that the reported actual sand and gravel production from the existing instream mines within San Luis Obispo County jurisdiction over the most recent 7-year period was 47% of the total annual permitted maximum extraction rate for those mines. If the mining-reduced sediment supplies and percent bedload bypass are estimated assuming 50% mining rate, the average annual Reach S-3 bedload sediment supply is in a negligible deficit of (-) 988 CY/yr (Table 4c). Historical bed elevation data suggests that stronger average annual deficits than this – in the range of negative 15,000-20,000 CY/yr – may have occurred over recent decades in Reach S-3. In fact, calculations show that an approx. 55-60-percent mining rate assumption corresponds best to the 2-2.5-ft historical bed elevation decline

seen in Reach S-3: it dropped about 1-1.5 feet at the 13th Street Bridge and about 2.5-3 ft at the Niblick and Hwy 46 bridges. However, it has been documented in this Plan that instream mining during the most recent 7-year period has occurred at less than 50% of the total annual permitted maximum rate, appearing to reflect, among other things, increased difficulty of obtaining permits and permit extensions. Furthermore, historical bed elevation data at San Miguel Bridge show that similar amounts of bed elevation decline have occurred in the upstream end of Reach S-1, and presumably then also Reach S-2, where the existing conditions bedload sediment budgets certainly have not been in deficit. Indeed, it needs to be clarified that 2-3-ft of bed elevation decline measured over 3-4 decades is a relatively small amount for a river as large as the upper Salinas. Such amounts of decline may be caused more by multiple factors influencing channel form, including any equilibrium shifts introduced by the catastrophic 1969 flood, increased riparian vegetation density from cessation of livestock grazing and introduction of treated wastewater discharges, effects of urbanization and reservoir storage, climatic variations, etc. Similar amounts of decline have been documented on California rivers without reservoirs, urbanization, and instream mines. The rather academic exercise of matching the estimated bedload sediment deficits to historical bed elevation data trends has at least perhaps illustrated that the 100% and 75% mining rate assumptions produce greater sediment budget deficits than can be explained by the available historical data.

For the purposes of initiating and implementing the Plan, **geomorph** recommends that the 50% mining rate assumption be used to estimate the existing conditions mining-reduced bedload sediment supplies and percent bedload bypass for the individual geomorphic subreaches and mine sites in the upper Salinas River watershed. **geomorph** submits that Table 4c contains the 'best available information' existing conditions bedload sediment budget for the upper Salinas River. Future investigators responsible for implementing ongoing development of the recommended Area-Wide Adaptive Management and Monitoring might elect to use a different mining rate assumption, or to supplant such assumptions with real excavation rate and bed elevation monitoring results, as would better substantiate the actual bed elevation response to mining rate and other factors.

5. POTENTIAL PANKEY PROJECT IMPACTS TO SPECIFIC ENVIRONMENTAL RESOURCE AREAS

5.1 Introduction

Section 5 lists, describes, and evaluates the potential impacts including cumulative impacts of the Project on fluvial geomorphology, riparian vegetation, groundwater, and fish passage.

The analysis focuses on the potential physical impacts of the Project's proposed maintenance of a long shallow excavated trench within the Salinas River bed to decrease river bed elevations (channel bed degradation) for some distance upstream and downstream from the excavation area, including upstream and downstream from the property boundary. Long-lasting severe channel bed degradation has the potential to result in:

- Increased river bank erosion and associated loss of riparian vegetation;
- Decreased spring groundwater table elevations beneath floodplain bars;
- Decreased groundwater storage capacity; and,
- Exposure or destabilization of infrastructure in the river corridor;

Maintenance of a long shallow trench in the Salinas River bed also has the potential to reduce suitability for fish passage including for salmonids, either by increasing turbidity within and downstream from the excavation areas during fish passage flows, or by decreasing low-flow channel confinement affecting flow depth and velocity.

The potential physical impacts of the Project's proposed long shallow trenches are evaluated with an emphasis on two scenarios, both likely to occur during the Project's proposed 20-year lifetime. The first scenario is a large flood occurring on the upper Salinas River when the proposed trenches are mined down to the proposed minimum (redline) elevation, 5 ft below the current bed elevation. This scenario may cause the greatest amount of instantaneous channel bed degradation within, upstream, and downstream from the Site. The second scenario is an extended duration drought occurring when the trenches are redlined. Resulting lack of sediment replenishment would leave the trenches redlined during the drought. This scenario would sustain potential local impacts to fish passage suitability and groundwater for the longest continuous duration.

The Project would also extract sediment from the bed of tributary Vineyard Creek. To some extent the Vineyard Creek Project element simply formalizes the ongoing repeat sediment removal activities the County contracts for maintaining flood conveyance through the Indian Valley Road Bridge. However, by extending the excavation area farther upstream and downstream from the bridge vicinity than in the past, the Project has the potential to induce bank erosion and associated loss of riparian vegetation, especially in places where individual riparian trees are rooted near the toe of the existing channel banks and in the downstream section of Vineyard Creek which cuts through the Salinas River terrace and floodplain bar deposits where more dense riparian vegetation is present. The summer-fall groundwater table is reliably more than several feet below the proposed redline for Vineyard Creek, and fish passage into Vineyard Creek during the range of fish passage flows on the Salinas is prevented under existing conditions by the naturally steep lower section.

The proposed Project would have other *direct impacts* associated with actual mining activities, including seasonal effects of equipment moving in the trench excavation areas and between the excavation areas and the mine operations and stockpile areas on the

floodplain bar and terrace surfaces. There are also seasonal and ongoing effects of material processing and material and equipment storage on the floodplain/terrace. These effects are described and evaluated elsewhere in the Project Record, but not in this Plan.

The Resource Agencies have commented that the Project may have *cumulative impacts* that are reach-scale and watershed-scale effects of sand and gravel extraction from the Pankey mine site when considered in addition to actual extraction from numerous active instream mines upstream and downstream from the Pankey site. Such cumulative impacts may potentially exacerbate the on-site and off-site effects on bank erosion, groundwater, and riparian vegetation listed above. Cumulative impacts may also include exposure and destabilization of pipelines, bridges, and infrastructure within the river corridor some distance from the Pankey Site. There is also a concern that cumulatively all of the instream mining on the upper Salinas River, if not monitored and managed appropriately, may cause systematic bed elevation lowering along the entire length of the mainstem river. Such widespread channel bed lowering may reinforce conversion of locally braided reaches into single-thread meandering reaches, and reduce the frequency and effectiveness of natural flood disturbance supporting diverse multi-aged riparian vegetation on floodplain bar surfaces. Widespread severe channel bed lowering also would potentially reduce the maximum volume of the groundwater storage basin by lowering the elevation that recent winter-spring precipitation driven groundwater accumulation drains to during the spring. Section 4 of this Plan contains a preliminary existing conditions sediment budget that is the primary technical basis for implementing an area-wide monitoring and management program for preventing cumulative impacts.

In Section 5, **geomorph** applies basic fluvial geomorphic, geotechnical engineering, and groundwater mechanics principles to evaluate the Project's potential physical impacts as accurately as possible, and submits for planning purposes a summary evaluation of the relative significance of the estimated potential impact for each resource area. Insights gained from the historical geomorphic analysis of the Site contained in Section 3 underpin the summary evaluations of potential impacts.

Stemming from this preliminary impacts analysis, **geomorph** recommended several changes to the Project Description in the current Project Record to improve the likely effectiveness avoidance and minimization measures such horizontal setbacks, and maximum annual permitted extraction volumes. Appendix A contains a preliminary excavation plan drawings (Permit Set) for the Project overlaid on high resolution air photos of the Site. The current Project Description captures the recommended changes.

In general, however, the actual impacts will depend on multiple factors, including the magnitude and effects of future floods, actual sediment replenishment and extraction rates, and future fluctuations in the summer-fall shallow groundwater table which may limit mining depth at the Site. Moreover, moderate and large floods have the potential to cause channel changes at the Site that are the result of both natural processes and mine influences. Environmental resources at and near the Site would be best protected and enhanced by implementing an adaptive management type monitoring program.

Section 6.5 outlines a recommended adaptive management type monitoring plan (S-1 Monitoring Plan) **geomorph** recommends be implemented by a County-appointed Environmental Monitor during the duration of mining activities at the Site. This Plan provides guidance as to the types of adaptive management directions and mitigation actions that might be appropriate to take depending on actual channel changes, but ultimately allows for the Environmental Monitor, in his/her expert opinion to propose management actions. It's believed the Environmental Monitor will be best positioned to recommend

appropriate actions with the insights into the ongoing site-specific geomorphic processes he/she would gain from the S-1 Monitoring Plan's biannual field observations and monitoring data compilation.

5.2 Potential Project impacts on the upper Salinas River corridor

The mainstem upper Salinas River supports tens of thousands of acres of nearly contiguous riparian forest, a portion of which is within and near the Project Site. Maintaining over the long-term the completeness and functional values of this riparian forest is undoubtedly a primary environmental management goal for the upper Salinas River watershed. Historical geomorphic analysis (Section 3) revealed a possible post-1969 trend toward low-flow channel bed incision and away from locally braided and transitional channel forms to more strongly single-thread meandering channel forms. Incision and channel form changes may explain part of the reduced frequency and effectiveness of floodplain bar disturbance as demonstrated by the relatively minor effects of the 1978 and 1995 floods. Neither bed incision nor channel form changes appear to completely explain observed reduced floodplain disturbance at the Site. Reduced floodplain bar disturbance regime may be resulting in both reduced loss of established riparian vegetation by flood disturbance and reduced new riparian vegetation recruitment on the formerly more active surfaces. That these processes may be occurring probably helps to explain why today's density of riparian vegetation within the Salinas River meander belt is as high or higher than it has been during historical times.

First, the proposed Project will have direct effects on riparian vegetation within the construction footprints of the ingress and egress roadways and the north and south processing areas. The County Staff Report states at p. 4-33 that approx. 0.48 acres riparian scrub would be disturbed and 0.7 acres non-native grassland area would be disturbed. A version of the Reclamation Plan would mitigate these impacts at an approx. 4:1 ratio by revegetating a total area of 5.13 acres comprised of four revegetation areas (R1-1.77 ac; R2-1.26 ac; R3-1.6 ac; R4-0.5 ac). Notably, the March 2008 Initial Study states that "Abbot's bush mallow (*Malacothamnus abbottii*) and Davidson's bush mallow (*M. davidsonii*) have the potential to occur on the subject property within the riparian areas and could potentially exist on the sandbar included in the proposed extraction area." The vegetation conditions and Reclamation Plan maps and documentation currently in the Project Record are not reproduced in this Plan document.

The proposed Project may also have effects on the fluvial geomorphology, groundwater, riparian vegetation, and fish passage suitability of the Salinas River in the project vicinity which may be potentially significant if not appropriately minimized and/or mitigated. As proposed, the mining operation would extract sand and gravel from the Salinas River bed to a maximum depth of 5 ft below the current bed elevations at the beginning of permitted mining period. The maximum extraction depth during any one annual cycle would be 2 ft. As shown in Appendix A, excavation from the Salinas would occur within two separate "north and south" excavation areas comprising a total combined river length of approx. 6,600 ft.

Presence of long shallow trenches within the low-flow channel of the Salinas River will cause channel bed elevation adjustments during winter floods within the excavated reach and extending as much as thousands of feet upstream and downstream (e.g., Figure 24). The channel bed elevation will temporarily decrease compared to existing conditions upstream and downstream from the excavation area. Figure 24 shows the predicted post-flood channel bed elevation profile (green) assuming the north and south excavation area trenches are redlined before a moderate to large flood. **geomorph** predicts that bed

elevations would decrease as much as approx. 1.5 ft near the upstream and downstream property boundaries and lesser, diminishing effects would extend as much as 5,000 ft downstream and 4,000 ft upstream from the Site. Temporarily reduced bed elevations within, upstream, and downstream from the mine site may have indirect impacts on reach-scale fluvial geomorphology, groundwater storage capacity, and riparian vegetation within this estimated approx. 19,000-ft long affected reach.

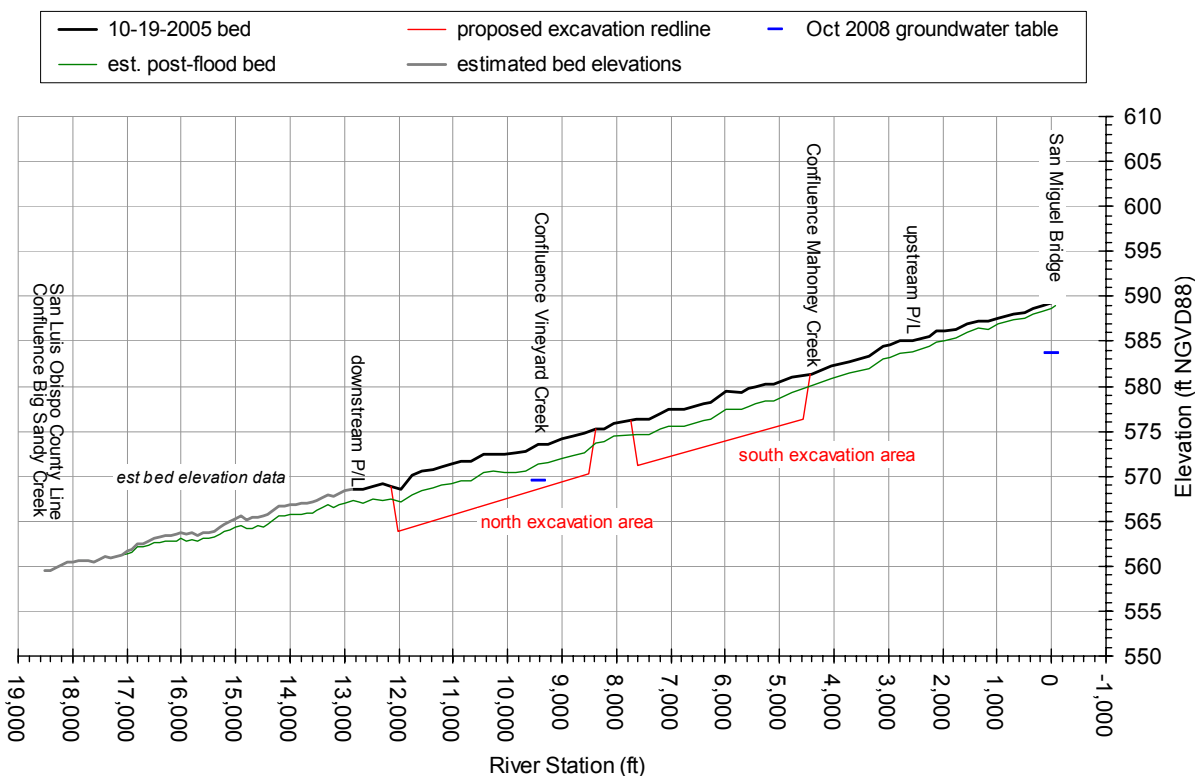


Figure 24. Longitudinal channel bed elevation profile of the Salinas River in the vicinity of the Pankey Sand and Gravel Mine Site (Source: 2- & 5-ft contour interval spot elevations from 10-19-2005 air photo). Maximum depth (redlined) mine trenches are shown for the proposed north and south excavation areas (red). The temporary adjusted channel bed elevation profile (green) represents the estimated likely post-flood channel bed elevation profile resulting from the presence of redlined trenches.

As proposed, the excavation area limits would be subject to the following horizontal and vertical limits:

- minimum 25-ft horizontal setback from property boundaries;
- minimum 20-ft horizontal setback from existing toe of bank or 10-ft setback from existing riparian tree driplines, whichever is greater;
- maximum 3H:1V trench side slopes;
- maximum 25H:1V trench head and toe slopes;
- maximum 2-ft annual total excavation depth (except within 400 ft from the Indian Valley Road Bridge roadway centerline);
- maximum 5-ft total excavation depth (redline depth) below existing bed grade at the beginning of Project; and,
- 1-ft vertical buffer between excavation and groundwater table.

Channel form. Temporarily reduced channel bed elevations may reinforce an already evidently ongoing process on the upper Salinas River – conversion of locally braided and transitional channel sections to single-thread meandering channel sections. Although historical geomorphic analysis of the study reach (see Section 3) suggests that the channel bed elevations reduced only about two vertical feet since the 1969 flood, planform adjustments and floodplain disturbance have evidently rather dramatically reduced. Reduced floodplain disturbance may result in reduced erosion of existing riparian vegetation but at the same time reduced recruitment of new riparian vegetation needed for supporting a multi-aged riparian forest. The available air photo and elevation data suggest that the trend toward more strongly single-thread meandering channel form may have been triggered by the channel resetting 1969 flood effects rather than or combined with the long-term effects of land use impacts (reservoirs, urbanization, agricultural expansion, instream mining). Increased vegetation density resulting from cessation of livestock grazing within the river corridor and introduction of treated wastewater discharges also reinforce this trend. Additional approx. 1.5-ft channel bed elevation declines caused by the Project will not cause but may reinforce the current trend toward single-thread meandering channel forms in the study reach. Reduced bed elevations should not persist after the end of the mine operations unless delayed bed elevation recovery is caused by a series of drought years and/or unmitigated cumulative impacts of upstream instream mines. Reverting to more strongly braided channel forms would in any event likely require a channel resetting flood. It may be that maintenance of locally braided channel sections on the upper Salinas River requires the action of channel resetting floods, such that intervening periods naturally see gradual trends toward more strongly single-thread meandering channel forms. If this is true, then shallow trench excavation may be seen to have negligible impacts on long-term average channel form.

geomorph submits that the Project will have a temporary less than significant impact on channel form in the study reach, primarily reinforcing the already present trend toward single-thread meandering channel forms and away from locally braided channel forms.

Groundwater storage capacity. Shallow groundwater occurs beneath the upper Salinas River valley floor. The groundwater table is highest during the winter and early spring and reaches a maximum elevation immediately after periods of prolonged and/or intense precipitation. The maximum possible groundwater table elevations are controlled in part by the channel bed elevation because the river acts as a natural groundwater drain when groundwater is high. Immediately after periods of prolonged and/or intense precipitation the groundwater table beneath the valley terraces is typically at least several feet higher than the channel bed elevation. Within days or weeks, the groundwater table declines until it is very near that of the low-flow water surface in the adjacent channel bed. After the rainy season, the groundwater table declines further until it is typically several feet below the dry channel bed during the summer, reaching annual minimum elevation at the end of the dry season. The summer-fall groundwater declines are greater where withdrawals for expanding agriculture and urban development are a greater percentage of the local shallow groundwater storage capacity. Conversely, the summer-fall groundwater declines are least where the groundwater is recharged by irrigation water application and discharges of treated water from wastewater treatment plants. Most recently, Todd Engineers (2007) compiled spring groundwater table elevations at representative wells from 1997 and 2006 (Figure 25). These data show that the spring groundwater table has risen about 10 ft along both the Salinas River and the downstream end of the Estrella River in the vicinity of San Miguel, including within the Project Site.

The 2006 edition of CA DWR Bulletin 118 reported that the Paso Robles Subbasin groundwater storage capacity remains long-term stable despite unspecified recent pronounced local overdrafts.

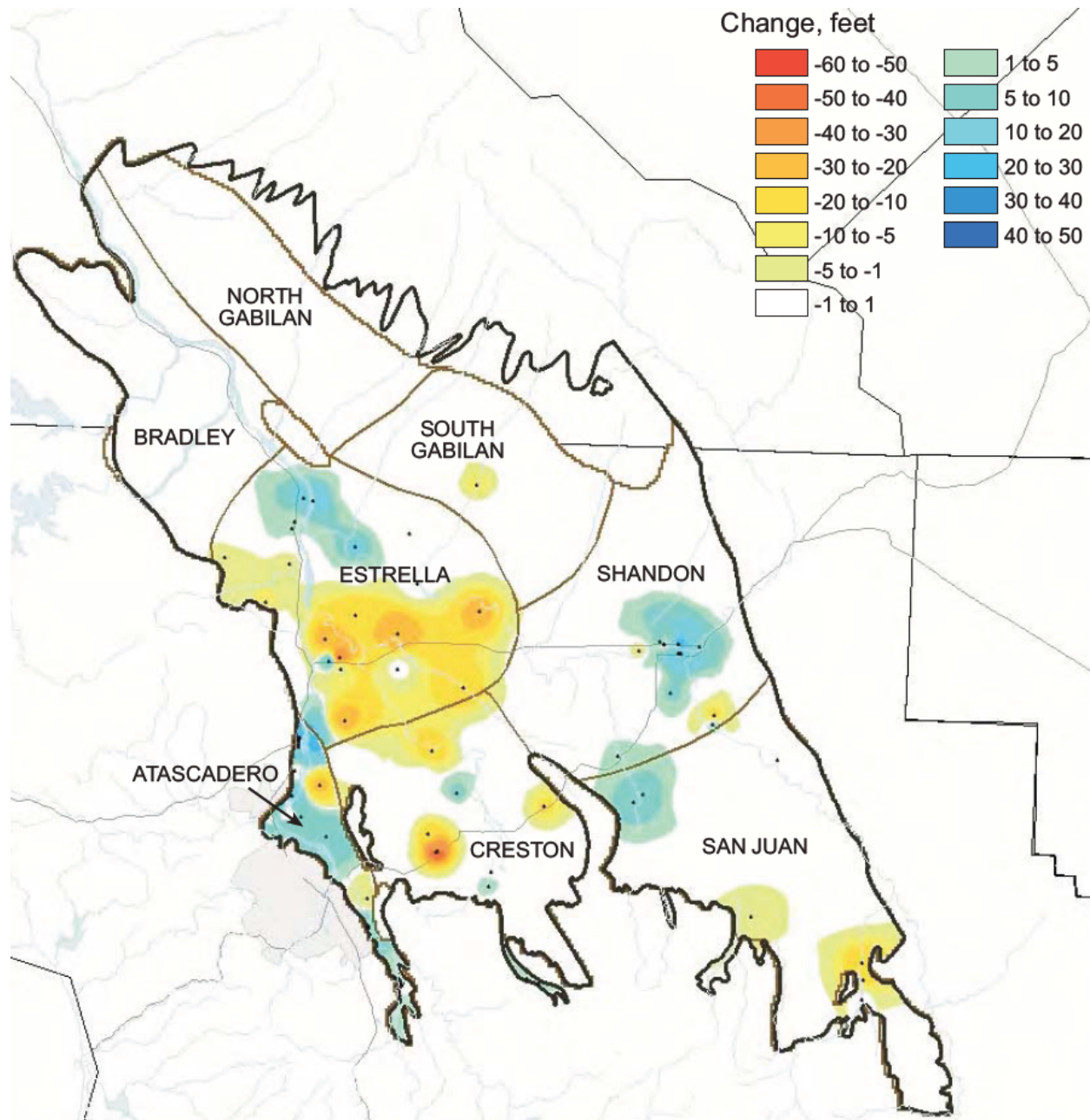


Figure 25. Change in groundwater storage, spring 1997 – spring 2006 (Excerpted from Todd Engineers 2007). Note that the spring high groundwater table and corresponding volume of local groundwater storage decreased (orange) in the rancheria area to the east of the mainstem Salinas River and increased elsewhere along the mainstem possibly as the result of increased wastewater treatment plant discharges and increased runoff from expanding irrigated acreage.

Lower Salinas River groundwater resources have been more extensively studied because of the importance of the ongoing reservoir storage groundwater recharge program for the expanding agricultural economy. Releases are made from Nacimiento and San Antonio River storage to the Salinas River to allow groundwater percolation. Future plans under consideration include installation of an inflatable rubber dam at the mouth of the river to improve groundwater recharge rate in the lower watershed. Watson et al. (2003) cited some data to demonstrate that the groundwater table has dropped approx. 50 ft beneath the lower watershed. Fewer and less comprehensive studies have been made of the upper Salinas River groundwater. Watson et al. (2003) suggested there are data demonstrating recent local groundwater table declines where there withdrawals have begun for new residential developments (e.g., near Paso Robles). Similar declines may have begun beneath reaches of the upper Salinas and its tributaries where grazing has been replaced by expanding irrigated row crop agriculture and viticulture. Watson et al. (2003) noted and sequential historical air photos confirm that riparian vegetation density has increased along the Salinas River corridor in recent decades, most markedly in the lower watershed downstream from regulated flow releases from Nacimiento and San Antonio Rivers. Indeed, air photos of the upper Salinas River corridor show that the riparian vegetation density increases dramatically immediately downstream from a wastewater treatment plant in Paso Robles, San Miguel, and other treated wastewater discharge points.

As proposed, the Project would excavate trenches in the Salinas River bed to a maximum depth of 5 ft below the channel bed elevations existing at the time permitted mining begins, but never within 1 vertical ft from the then existing groundwater table beneath the bed. The Resource Agencies have requested that the baseline existing conditions groundwater table dynamics be analyzed and presented for evaluating the potential for the groundwater to be in close proximity to the proposed redline elevations at the Site. However, there are few recent historical groundwater data for compiling a baseline existing conditions groundwater analysis. As proposed, the Project would install seven groundwater piezometers and carefully monitor and report the seasonal groundwater table fluctuations along the length of the Site beginning in the spring before the first summer-fall excavation season. Please see the preliminary excavation plan drawings (Appendix A) for proposed piezometer locations and Section 6 for description of the proposed groundwater monitoring, setback compliance, and reporting procedures.

The USGS maintains only one well near the Site (GAMA well PR-08). But this well is located on the terrace west of the upstream end of the proposed South Excavation Area. It is designed by USGS as a water quality monitoring well. Being located adjacent to the waste water treatment plan, the fluctuations in the groundwater table elevations there would not be completely representative of the study reach or the Site conditions.

The County maintains a groundwater monitoring database consisting of data from 839 wells. A subset of these wells should be expected to have been drilled and screened in the shallow alluvium within or directly adjacent to the Salinas River corridor and so represent the groundwater table beneath the river bed. **geomorph** submitted a data request to the County seeking access to the groundwater table elevation for wells screened in the shallow alluvium within or immediately adjacent to the Salinas River corridor. The County reported that the groundwater well database cannot be queried according to proximity to the river, depth of screening, or geologic formation information. The County recommended submitting a refined data request which identifies which of the 839 wells are within Township-Range-Sections that intersect the river corridor. **geomorph** submitted a refined data request in March 2009 listing the Township-Range-Sections that intersect the recent alluvium (Appendix J). According to this list, at least 36 monitoring wells are in Township-Range-Sections that intersect the recent Salinas alluvium and 195 other wells may be in

overlapping sections. The County had not responded to the refined data request as of the date of this Plan document, and so these unknown number and quality of data are not reviewed here. Still, only 4 of the monitoring wells in the County database are within the same Township-Range-Section as the Site vicinity. Ultimately, these County data may or may not provide sufficient resolution for a baseline conditions analysis for the study reach or the Site. However, using the available shallow alluvial groundwater wells in the existing monitoring database and augmenting it with new monitoring wells (e.g., at existing and new proposed instream mine sites) is a recommended component of the proposed area-wide monitoring and management plan (see Section 6, Appendix J).

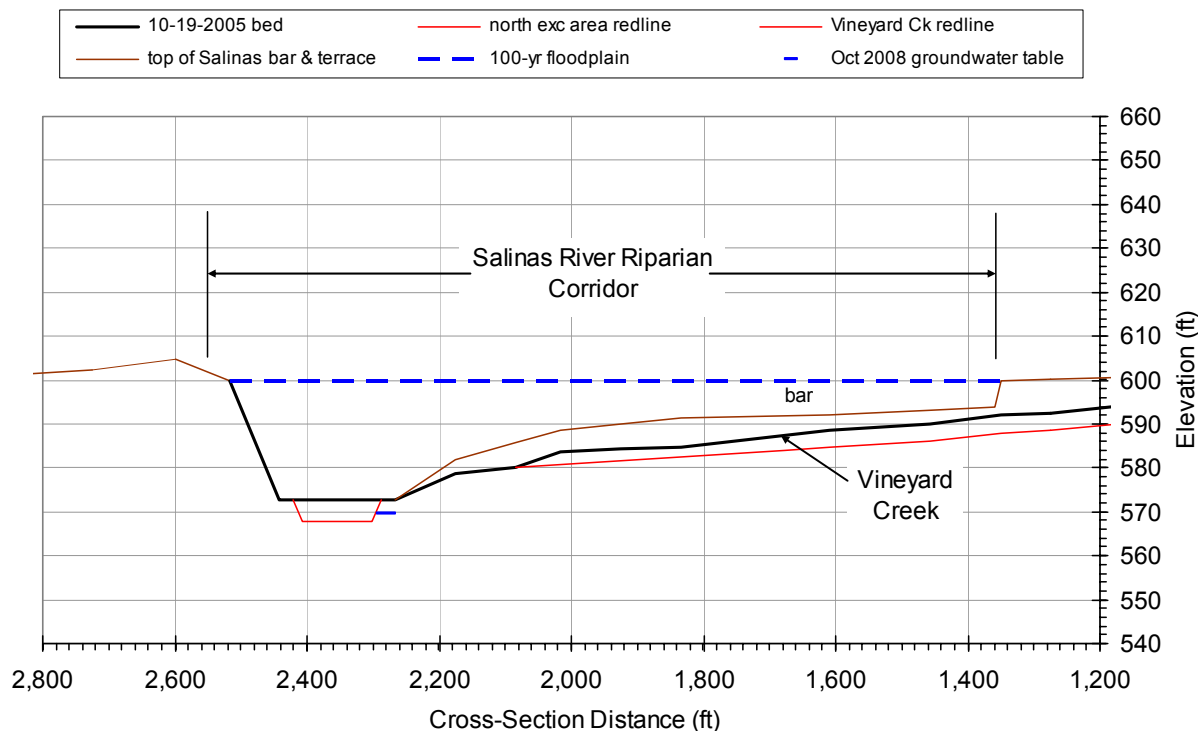


Figure 26. Cross-section of **upper Salinas River** and longitudinal channel bed elevation profile of Vineyard Creek tributary to the Salinas River in the vicinity of the proposed Pankey Sand and Gravel Mine Site (Source: 2- & 5-ft contour interval spot elevations from 10-19-2005 air photo). Maximum depth (redlined) mine trench of the proposed north excavation area is shown (red) as is the proposed redline excavated flowline of Vineyard Creek immediately upstream from the Salinas River mining trench.

Also responding to requests from the Resource Agencies for baseline existing conditions groundwater table information at the Site, SDC (2008) excavated test pits in the Salinas River bed at two locations in October 2008. SDC (2008) found the summer-fall groundwater table was about 4 ft below the current Salinas River channel bed elevation near the Vineyard Creek confluence and about 5 ft below the bed nearer the San Miguel Bridge. These single-year summer-fall groundwater table data points are shown on Figure 24 and Figure 26 for displaying the proximity to the proposed redline elevation in the excavation areas. It is unknown to what extent local summer groundwater table elevations are supported by groundwater underflow from the 52.3-sq mi Vineyard Creek watershed tributary to the Site (probably negligible), but it appears from Figure 25 that increased wastewater treatment plant discharges near the upstream end of the Site may be supporting relatively high summer-fall groundwater table elevations at and near the Site.

Figure 24 shows that 5-ft-deep trenches in the existing Salinas River bed would have intersected the October 2008 groundwater table. However, the proposed Project would have been required to maintain a minimum 1-ft vertical setback from the then existing groundwater table. Therefore, if the Project had been operating in 2008 as currently proposed, excavation deeper than about 3 ft below the existing channel bed elevations would not have occurred. If the October 2008 groundwater table is similar to the average annual summer-fall minimum then it appears that groundwater table elevations will prevent trench excavation as deep as the 5-ft maximum redline during most years during the period of mine operation.

The shallow groundwater table will reach its annual and long-term maximum elevations during the winter immediately after prolonged and/or intense precipitation. The maximum instantaneous groundwater storage occurs when the maximum groundwater table elevation is reached. Instream mining at the Site may somewhat lower the maximum attainable groundwater table elevation especially the table elevations nearer the Salinas River channel because the temporarily mining-reduced channel bed elevations provide a lower drain elevation as flood waters recede. This effect is viewed to be temporary and insignificant because it impacts only the infrequently and briefly filled highest elevation portion of the existing groundwater storage volume. Instream mining would not affect the overall long-term stable groundwater storage capacity of the Paso Robles Subbasin, the vast majority of which is comprised of deep permanent groundwater stores within the Paso Robles Formation lying beneath the Salinas River bed elevation.

geomorph deems the potential for increased evapotranspiration of groundwater rising by capillary action from below the 1-ft vertical buffer to be a negligible term in the local groundwater budget during all seasons. During summer the budget should be strongly dominated by down valley aquifer transmission, irrigation withdrawals, and evapotranspiration by riparian vegetation. Accordingly, maintaining a one foot vertical setback from the groundwater table appears to be a sufficient avoidance and minimization measure for groundwater quantity and quality protection.

***geomorph** submits that the Project will have a temporary less than significant impact on maximum groundwater storage capacity in the vicinity of the study reach and a temporary less than significant impact on groundwater quantity and quality.*

Groundwater availability for riparian vegetation. The temporarily Project-reduced groundwater drain elevation within the study reach might also reduce average spring groundwater table elevations beneath the existing riparian forest on the coarse-grained sandy floodplain bars flanking the low-flow channel. There may be an impact to the establishment, survival, and growth of existing and future riparian vegetation on the high bar surfaces. Any impact to vegetation is probably negligible during the winter because lower air temperatures and more frequent precipitation support higher moisture content in the alluvium. As air temperatures increase and surface flows dissipate during spring, the somewhat deeper groundwater table might impact vegetation, maybe especially the establishment of new riparian seedlings whose roots need to grow vertically downward to 'track' the typical downward movement of groundwater following the flood season (e.g., McBride and Strahan 1984).

According to the potential depth and length of bed elevation lowering predicted by this preliminary impacts analysis (Figure 24), the spring groundwater table within and near the Project excavation areas may have at times during the Project lifetime a 1.5-2.5-ft lower drain elevation during the Spring. Accordingly, the spring groundwater table beneath the

bar surfaces near the edges of the low-flow channel would drain to 1.5-2.5 ft lower in the spring than under pre-Project conditions. The difference would be somewhat less beneath bar and terrace surfaces farther from the low-flow channel.

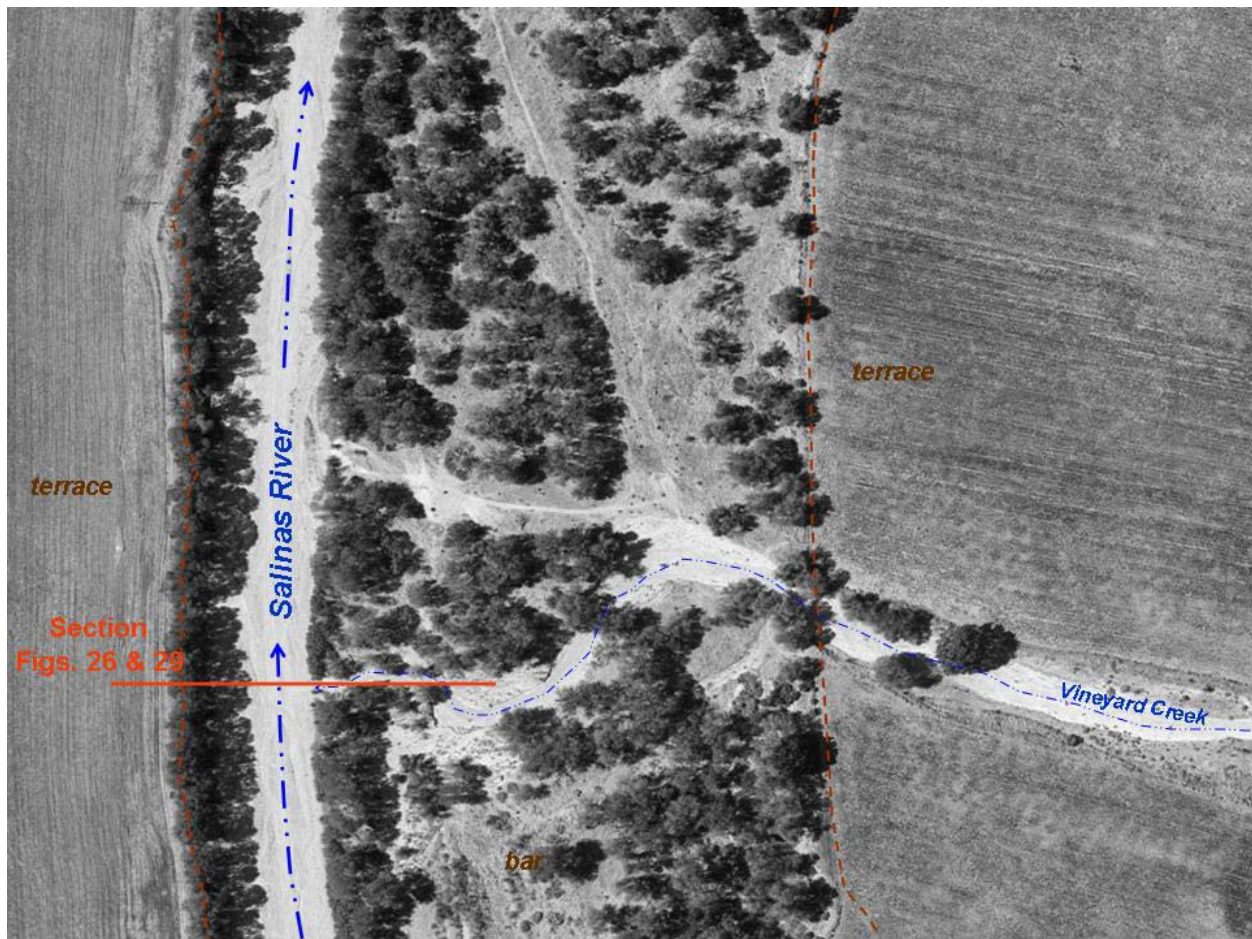


Figure 27. October 19, 2005 air photo of the upper Salinas River riparian corridor at the Vineyard Creek confluence. The coarse-grained floodplain bar and superimposed Vineyard Creek alluvial fan are to the right of the approx. 170-ft-wide upper Salinas River low-flow channel. Within this view, the floodplain bar surfaces vary from 6 to 18 ft above the adjacent low-flow bed surface. The approx. alignment of the cross-section in Figures 26 and 29 is shown. (Source: Aerial Photomapping Services, Inc.)

In general, the existing uniformly dense riparian vegetation conditions at the Site suggest that 1.5-2.5-ft differences in depth to spring groundwater table do not appear to influence riparian vegetation establishment, survival, and growth. For example, bar surfaces that are as much as 18 ft above the adjacent low-flow channel bed host similar vegetation composition and density as surfaces that are as few as 6 ft above the channel bed (Figure 27). For more extensive and detailed examples, please see the detailed 2005 elevation contours overlaid on 2005 air photos of the Site (Appendix A). These observations suggest that if the lower spring groundwater table elevations were to affect riparian vegetation establishment and survival at the Site, it would be on the relatively highest existing bar surfaces.

Lower spring groundwater table elevations might also disproportionately affect existing riparian vegetation on mid-channel bars (termed vegetated islands in earlier project

reports). By enforcing horizontal setbacks from the toes of existing low-flow channel banks and existing riparian vegetation drip-lines, the Pankey Project would create an irregular shaped excavation area boundary, particularly in the south excavation area where the locally braided channel contains multiple low-elevation vegetated mid-channel bars (e.g., Figure 28). Avoidance of the tree drip lines surrounding these vegetated mid-channel bars would indeed create “vegetated islands” within the excavation area. If the south excavation area trench is ‘redlined’ to the maximum 5-ft depth, then the vegetated island surfaces will rise approx. 7-10 ft above the trench floor and about 7-8 ft below the estimated post-flood trench floor shown in Figure 24 (i.e., spring conditions). These surfaces would not be too high to support riparian vegetation similar to the generally higher bar surfaces hosting most of the existing riparian vegetation in the corridor. However, being of small surface area the effects of groundwater table draining to the entire perimeter would prevent the winter and early spring groundwater table from more than briefly rising above the trench floor elevation. Therefore, it can be said that the most severe impacts to groundwater availability for riparian vegetation life cycle requirements would be within these vegetated island areas in the south excavation area (Figure 28).

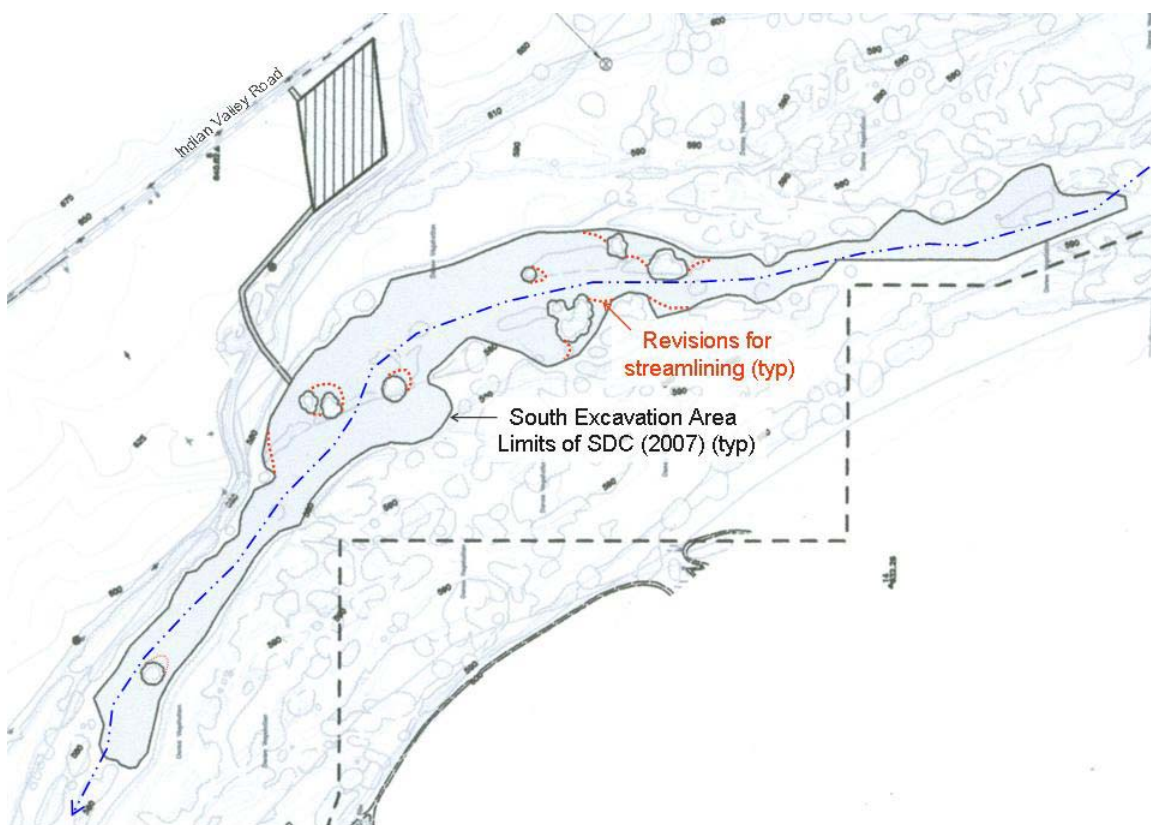


Figure 28. Detail from Site Plan showing excavation area limits in the south excavation area proposed by SDC (2007). The irregular planform of the excavation area limits results from horizontal setbacks from existing channel and island banks and riparian tree driplines. Also see the proposed revised excavation area boundaries in Appendix A.

Especially under redlined conditions these islands would also be subject to intensified erosion pressure during floods. **geomorph** believes that riparian vegetation on vegetated islands resulting from avoidance by the excavation area will be lost to bank

erosion before it may be lost to groundwater availability effects. As discussed below re. potential for losses of riparian vegetation to bank erosion, **geomorph** changed the originally SDC-proposed excavation area boundaries shown in Figure 28 to create more streamlined trench boundary for more evenly distributing the erosion pressure on the 3:1 sloped trench banks and minimizing the erosion pressure on the vegetated islands and the oversteepened terrace banks, where present. The revised excavation area boundaries also resulted in fewer and larger, more streamlined vegetated islands. Please see Appendix A to review the proposed revised excavation area boundaries.

In general, the riparian vegetation on the upper Salinas River corridor plant community that has evolved for more than at-a-site 1.5-2.5-ft fluctuations in bed elevations over time. Such amounts of temporary bed elevation rise and decline are typical for intermittent locally-braided sand-bedded channels which periodically transport extremely large sediment loads and drastically change channel form during large channel resetting floods.

What historical groundwater table baseline data are confirmed to exist at this time for the Site vicinity are limited to: (1) data from wells near the waste water treatment plant and elsewhere which Todd Engineers (2007) used to show that spring groundwater table had risen more than 10 ft within and near the Site from 1996 to 2007 (Figure 25); and (2) October 2008 groundwater table measurements on the Salinas River bed near the Vineyard Ck confluence and San Miguel Bridge. The former data suggest that the Spring groundwater table elevations at the Site are substantially higher than historical natural conditions as the result of increased wastewater treatment plant discharges and other increased recharges on the lower Estrella River. Probably influenced most by the increased wastewater treatment plant discharges, the latter data suggest that the summer-fall groundwater table elevations within the Salinas River excavation areas would probably be high enough in most years to prevent mining excavation as low as the proposed 5-ft redline.

***geomorph** submits that the Project will have a temporary less than significant impact on groundwater availability for riparian vegetation establishment and growth within the upper Salinas River riparian corridor.*

Bank erosion. Temporarily reduced low-flow channel bed elevations within the study reach (e.g., Figure 24) may increase the susceptibility of existing low-flow channel banks to bank erosion in so far as the native material at existing grade within the horizontal setback from the toes of the banks may evacuate during winter floods and thereby lower the bed elevation at the toe of the bank. Figure 29 shows an example typical cross-section within the proposed north excavation area (Figure 27). The proposed 20-ft horizontal setbacks from the existing toe of the channel bank are shown. Also shown is the proposed maximum "redlined" 5-ft-deep version of the excavation trench with maximum 3H:1V side slopes (trench banks). For these proposed avoidance and minimization measures, the toe of the redlined trench would lie as close as 35 horizontal feet from the nearest channel bank.

During winters without floods or only relatively low floods, the native bed material left within the horizontal setbacks is expected to substantially remain in place, such that there would be no impacts to bank erosion within or near the Site. There are no reliable analytical procedures for accurately estimating what percentage of years this would be true. As a preliminary estimate only, **geomorph** predicts that trench bank erosion would be minimal such that a portion of the native material within the horizontal setback would remain in place continuously along both banks within the Site during at least 40% of years.

In another 40% of years the setback material would substantially remain, but would be completely evacuated by trench bank erosion to expose the existing bank in places, especially along outside bends (approx. 2 locations at the Site). In the remaining 20% of years (e.g., corresponding to years with floods exceeding the approx. 5-yr flood) significant portions of the setback material would be evacuated exposing longer sections of the existing channel banks. Only in rarer years (e.g., during years with approx. 20-year floods or larger) would it be likely that the resulting lower bed elevations along the toes of the existing channel banks would be significant enough to induce bank erosion in amounts exceeding natural pre-mining condition. Here the concept of the peak annual flood recurrence interval is applied for describing frequency. However, bank erosion may be more influenced by the number of floods and total duration of floods exceeding a particular sediment transport threshold, combined with factors influencing the wide interannual variation in sediment load on the Salinas especially downstream from the Estrella River confluence.

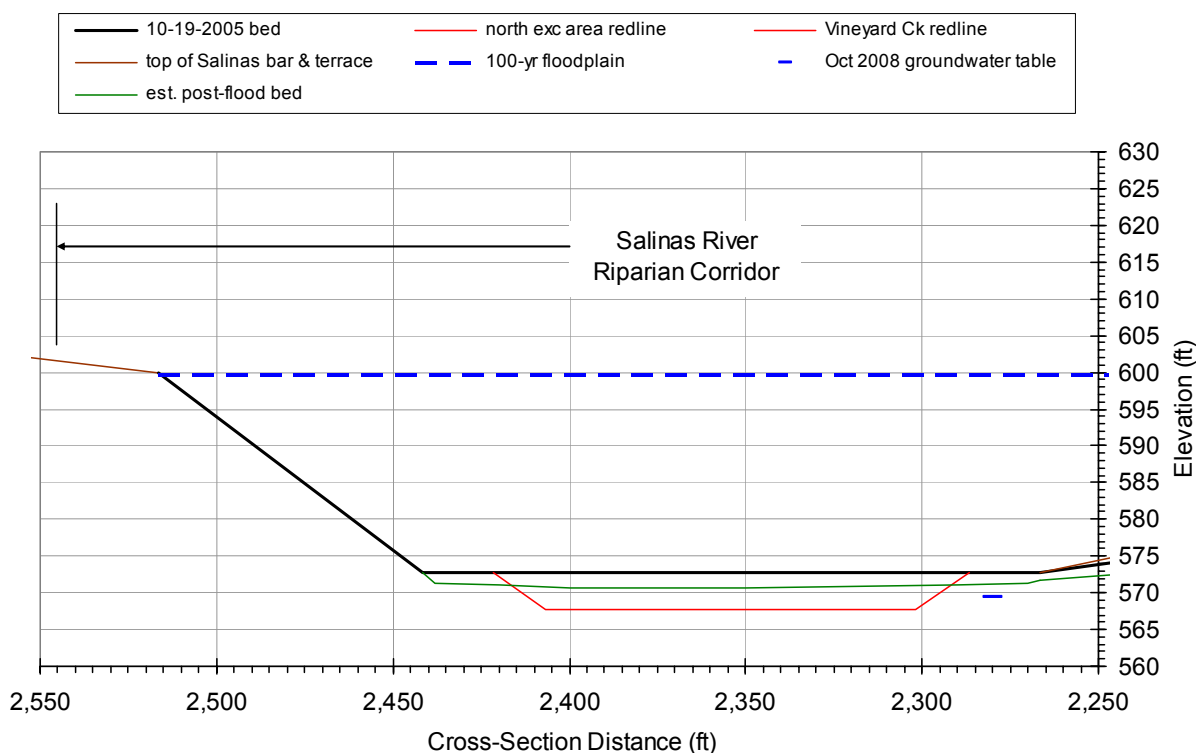


Figure 29. Cross-section of Salinas River and longitudinal channel bed elevation profile of Vineyard Creek tributary to the Salinas River in the vicinity of the Pankey Sand and Gravel Mine Site (Source: 2- & 5-ft contour interval spot elevations from 10-19-2005 air photo). Maximum depth (redlined) mine trench section is shown for the proposed north excavation area (red). The excavation area is setback 20 horizontal feet from the existing toe of the channel bank and the maximum finished side slope (trench bank) grade is 3H:1V. The temporary adjusted channel bed elevation profile (green) represents the likely channel-averaged post-flood channel bed elevation profile resulting from the presence of redlined trenches.

There are no reliable analytical procedures for accurately predicting the extent to which the bed elevations at the toe of the existing channel bank would reduce during a flood or series of floods, e.g. for a range of alternative horizontal setback widths. According to basic geomorphic reasoning, as a preliminary estimate only, **geomorph** predicts that there may be, on average, about 1.0-1.5 feet of bed elevation lowering at the toes of the existing

channel banks during a worst-case scenario event (e.g., moderate to large flood occurring when the excavation trenches are redlined) (e.g., Figure 29). This amount would diminish with distance downstream from the excavation areas, possibly averaging 0.2-0.4 feet within approx. 3,000 ft upstream and downstream from the excavation areas. At outside channel bends directly adjacent to the excavation areas (condition shown in Figures 27 and 29) there may be as much as 4 ft of local bed elevation lowering along the toe of the outside channel bank.

Within and near the Site the existing low-flow channel banks are approx. 6-12 ft high adjacent to modern floodplain bar units and approx. 20-35 ft high where they are cut in more cohesive and relatively erosion resistant terrace material. It is notable that existing conditions terrace banks have held up at 1H:1V and steeper slopes during the entire 40 years since the most recent significant bank erosion event (1969 flood). During floods like the 1969 flood and the 1995 flood which exceeded the magnitude of the 1969 flood, the channel bed materials within the study reach are scoured (i.e., liquefied) to a depth at least 3-5 feet below the channel bed surface. For example, Watson et al. (2003) predicted a 5-7-ft liquefaction depth during floods on the mainstem Lower Salinas River based on evaluation of scour chain and sediment transport data at the Spreckles gage. Bed liquefaction temporarily reduces bank stability by lowering the toe elevation of the solid material physically resisting against rotational bank slump failure.

Within the Site, the temporarily 1.0-1.5-ft average reduced channel bed elevations along or near the toes of the channel banks will increase the effective bank heights by as much as about 5-10%. Within 3,000 ft upstream and downstream from the excavation areas, the estimated 0.2-0.4-ft reduced channel bed elevations will increase bank heights by about 1-4%. According to geotechnical engineering principles, higher banks are more susceptible to bank slump failure. However, there are no reliable analytical procedures for accurately translating this effect into actual acres of bank erosion and associated loss of existing riparian vegetation. This is because bank erosion potential is also a function of strength, cohesion, root density and strength, saturation, and other factors, especially flood magnitude and flood duration. Indeed, some amount of bank erosion and nearbank riparian vegetation loss is natural and to be expected. Historical geomorphic analysis (see Section 3) indicated that the 1995 flood (approx. a 75-year flood event) produced measurable bank erosion and loss of nearbank riparian vegetation along less than 5% of the channel banks in the study reach. This is contrasted with the longer duration 1969 flood which completely realigned the low-flow channel and removed all of nearbank riparian vegetation over 1,000s of feet.

Properly aligning the trench banks by careful excavation area design will minimize the potential bank erosion effects within the Site. Note that uniformly applying horizontal setbacks from existing channel and vegetated island banks and riparian tree driplines results in irregular excavation limits, particularly in the south excavation area (e.g., Figure 28). Irregular trench bank configuration would subject some of the native material reserved within the horizontal setbacks to direct erosion pressure. To minimize these effects, **geomorph** made site-specific hydraulic-design revisions to “streamline” the excavation area boundaries to the extent practically feasible – compare the current proposed excavation area boundaries for the south excavation area (Sheet C-3 in the attached Permit Set, Appendix A) to the original proposed boundaries shown in Figure 28.

Again, it’s important to note that the carefully designed horizontal setbacks would not protect against normal expected bank and vegetated island erosion during moderate to large floods. The existing vegetated channel banks flanking the low-flow channel within and upstream and downstream from the Site have shown remarkable stability during recent

moderate and large floods (e.g., 1995 flood). Accordingly, these channel banks may ultimately show little if any effects of the proposed trench excavation and mining-reduced bed elevations. On the other hand, the existing lightly vegetated mid-channel bars within braided sections of the river are transitory geomorphic units prone to partial or complete erosion during relatively low floods. It is probably unreasonable to expect horizontal setbacks to prevent erosion of the vegetated islands that would result from avoiding excavation existing vegetated mid-channel bars in the proposed south excavation area. Therefore, despite the avoidance and minimization measures recommended by this Plan, it is likely depending on the flood regime during the permitted period of mining at the Site that the vegetated islands depicted in Figure 28 and revised in Appendix A will be substantially eroded away during the Project lifetime. Upon cessation of mining, these mid-channel bars will immediately be reformed during the first subsequent moderate to large flood and resume their temporary cyclic riparian vegetation hosting functions.

In summary, although there are no reliable analytical methods for technically demonstrating adequacy in such a dynamic system, **geomorph** finds 20-ft horizontal setbacks from existing channel bank toes and 10-ft setbacks from existing riparian tree driplines, whichever is greater, and with the resulting excavation area boundaries as have been revised for “streamlining” (Appendix A), to be generally sufficient for avoiding and minimizing potential Project impacts on bank stability and associated loss of riparian vegetation. However, any amount of accelerated bank erosion the Project causes may be considered a significant impact because of the associated losses of riparian vegetation, maybe especially because the accelerated erosion may occur off-Site across property boundaries. Of course, whether or not such impacts should be projected to be significant or less than significant depends on standards for measuring relative significance. The maximum amounts of Project-induced vegetation loss are certainly less than may occur as the result of natural floods. Indeed, in general, because bank erosion is a natural process it should be difficult in practice to isolate and attribute increments of bank erosion to the effects of the mine trenches, particularly following moderate or large floods when there is substantially greater potential for both mining-influenced and natural bank erosion. **geomorph** recommends that a primary purpose of the recommended S-1 Monitoring Plan (Section 6) will be to use expert interpretation of airborne LiDAR data and repeat ground survey monitoring data and expert repeat field observations to detect excessive bed elevation changes or abnormally rapid bank erosion rates within, upstream, and downstream from the Site. The County-appointed S-1 Environmental Monitor would use these cumulative data analyses and professional judgment to recommend delays or reductions in mining or physical bank and vegetation restoration work as needed to mitigate for the portion of any identified accelerated bank erosion and associated riparian vegetation loss attributed to the effects of the Project.

***geomorph** submits that the Project will have potentially significant impacts on bank erosion and associated loss of nearbank riparian vegetation within the Site and to a lesser degree within 1,000’s of feet upstream and downstream from the Site but that these potential impacts will be mitigated to less than significant by implementing the recommended adaptive management type S-1 Monitoring Plan per the discretion of the County-appointed S-1 Environmental Monitor.*

Fish passage. Watershed-scale salmonid habitat distribution maps prepared by the Center for Ecosystem Management and Restoration (CEMAR) Southern Steelhead Resources Project (<http://www.cemar.org/SSRP>) show the upper Salinas River near the Site is historically and presently a migration corridor for salmonids to access current suitable habitats in the small tributaries draining the southern Santa Lucia Mountains. The hydrology of the upper Salinas

River has been only partially modified by Santa Margarita Reservoir. Historically and presently the intermittent upper Salinas River flows provide sufficient depth and velocity for fish passage for only a few to several days in most years. That is, under existing conditions, suitable passage conditions are limited in most years by the relatively short duration of flows large enough to create enough depth on the low-flow channel bed. The short duration of suitable fish passage flows can be characterized as a small “window of opportunity” for fish passage, emphasizing the need to avoid and minimize potential Project impacts to fish passage suitability when the ‘window’ is only briefly open.

As reviewed in Section 3 (e.g., see Figure 14) the low-flow channel width at the Site fluctuates according to the recent flooding history and has recently decreased to what appears to be a long-term minimum reach-average of about 160 ft. Within the Site, the existing conditions low-flow channel width is locally as narrow as approx. 135 ft in the strongly single-thread meandering reach and locally as wide as approx. 275 ft in the locally braided reach where there the total width is comprised of multiple low-flow channels at approx. the same bed elevation.

After the first season of Project operation, there would be a maximum 2-ft-deep trench excavated within and along an approx. combined total 6,600-ft length of the existing low-flow channel. With minimum 20-ft horizontal setbacks on both sides and maximum 3H:1V side slopes (trench banks), the Project would have effectively created a new low-flow channel that is on average a minimum of 52 ft narrower than the existing low-flow channel. Assuming the native material volumes left within the horizontal setback areas flanking the excavation trench banks are not entirely eroded during the first few late fall and early winter storm flows (see bank erosion section above), low to moderate storm flows that season would produce greater flow depths in the excavation trenches than they would have within the existing conditions low-flow channel. The excavation trenches would also be wide enough to prevent excessive velocities during the range of fish passage flows. Therefore, to the extent that the excavation trenches are narrower than the existing low-flow channel, the hydraulic conditions for fish passage are better within the trenches than within the existing pre-mining low-flow channel. However, other conditions also need to be satisfied for minimizing and avoiding Project impacts to fish passage.

The existing low-flow channel bed is relatively flat, or plane-bedded, over long sections especially in the strongly single-thread meandering reach where the north excavation area is located. Therefore, applying the annual maximum 2-ft excavation depth would result in a similarly flat trench channel bed at the beginning of the winter flow season. To provide improved fish passage conditions within the trench channels, **geomorph** revised the excavation plan and the permit conditions to require the trench floor be excavated an additional 0.5 ft along the centerline of the trenches so that the finished trench floors would slope in the cross-channel direction at a minimum 1% slope to the trench centerline (e.g., shown schematically in section on Sheet C-2 in Appendix A). This way, by creating a subtly v-shaped channel, the hydraulic conditions for fish passage through the trench channels would be optimized to the extent practically feasible.

Under existing conditions, the first few late fall and early winter storms produce flows of unknown turbidity with unknown effects on fish passage suitability during the range of passage flows. Some investigators have observed there may be an “armor layer” on the surface of the existing channel bed that is composed of somewhat coarser bed material than the underlying bed material. Such an armor layer, if present, might minimize turbidity during low flows, possibly including flows within the range of fish passage flows. By removing the surface bed material, the Project would remove the armor layer, if present, such that the first few late fall and early winter flows might produce more turbidity than

they would have under existing conditions. There are no reliable analytical procedures for accurately estimating the potential Project impacts to turbidity during fish passage flows within and downstream from the Site. Turbidity within the Site also depends on the turbidity of flows entering the Site and other factors, including how fast the armor layer, if present, would naturally reestablish, and if it would establish at flows near in magnitude to the range of fish passage flows.

As previously described by SDC (2007), the Project would excavate maximum 4H:1V (25%) head and toe slopes, into and out of each excavation trench. **geomorph** recommends conditioning the Project to instead require minimum 25H:1V (4%) head and toe slopes, into and out of each excavation trench (Appendix A). The recommended maximum 4% head slope is not too steep for adult and juvenile salmonids to pass, and would minimize the potential for differential erosion of the head slope face (e.g., gullyng) as may form a steep head cut feature that is less suitable for fish passage than the pre-mining conditions at the Site.

Under existing conditions at the Site the maximum local slope between October 19, 2005 spot elevations taken along the low-flow channel flowline is 0.8%, but there are multiple 4% and greater sloped surfaces on the low-flow channel bed that are quasi-stable during low floods. For example, the 3-4-ft high approx. 33%-sloped slip face aligned roughly along the 580-ft contour in the locally braided reach was in the same position in 2005 and 2006 air photos, and more recent Google Earth imagery.

For the redlined condition, the finished 4%-sloped head slopes would be similar to approx. 125-ft long ramps into the 5-ft-deep trenches. There are no reliable analytical methods for accurately predicting whether or not the 4% head slope is too steep to prevent against the potential for gullyng and steep headcut advance to reduce fish passage suitability. Whether or not the head slope differentially erodes during floods depends on multiple factors including flow magnitude, duration, and sediment concentration. **geomorph** recommends conditioning the Project to require twice annual head slope area inspections by the S-1 Environmental Monitor. The S-1 Environmental Monitor may then identify differential erosion or other processes contributing to poor hydraulic conditions for fish passage and require amelioration by direct interventions and/or revised minimum head slopes or other head slope design changes during the duration of mining activities at the Site. Please see Section 6 for a description of the recommended S-1 Monitoring Plan.

On other rivers with salmonid passage concerns, instream mining has been reduced where it has been determined feasible to excavate bar surfaces separate from the low-flow channel. And in some specific cases bar excavation areas have been configured to simulate the geomorphic shape and hydraulic function of a natural floodplain scour channel. Figure 30 shows an example conceptual design for alternative floodplain scour channel excavation at the Site. The example configuration is intended to mimic the same low-flow channel configuration that existed at the Site before the 1969 flood. For example, see Figure 4 and historical air photo sequence in Appendix B. In detailed design, the floodplain bar trenches would be configured to allow low-flow connectivity at their downstream ends by daylighting through to the low-flow channel. The trenches would be designed to prevent low-flow connectivity at their upstream ends by setting the gradual maximum head slopes back from the existing low-flow channel banks. This way, the floodplain bar trenches would provide backwater refugia habitat at their downstream ends without also producing nuisance attraction flows during fish passage flows.

It can be seen from this conceptual design example applied to the Site that the alternative floodplain bar excavation area would substantially avoid potential Project impacts to fish

passage while yielding similar quality and quantity sand and gravel material from a similar-sized excavation area footprint. As shown, and assuming 180-ft trench top width, 3H:1V side slopes, and a minimum trench floor elevation not more than 3 ft below the adjacent low-flow channel bed elevation, the alternative flood scour channel excavation would yield a total excavation volume of approx. 600,000 CY. This amount is equivalent to the estimated 12-year extraction total for the Project as proposed with an annual maximum extraction rate of 96,000 CY/yr, assuming actual mining would proceed at 50% of the annual maximum rate. (Please see Section 4 for more information about the 50% mining rate assumption).

As shown, the Vineyard Creek bed would drop about 15 feet from the higher terrace directly into the north floodplain bar excavation area. This steep condition is virtually the same as existed before the 1969 flood. Headcut advance could be prevented on Vineyard Creek by the installing a temporary rip-rap grade control structure on the creek bed immediately upstream from the Salinas River corridor. Vineyard Creek tributary flows would be directed into the north flood scour channel excavation area where they would produce an estimated 10,000 CY/yr bedload sediment replenishment rate in the trench. (For example, please see existing and proposed conditions sediment budgets for Vineyard Creek in Section 4.4 and Section 6.2, respectively.)

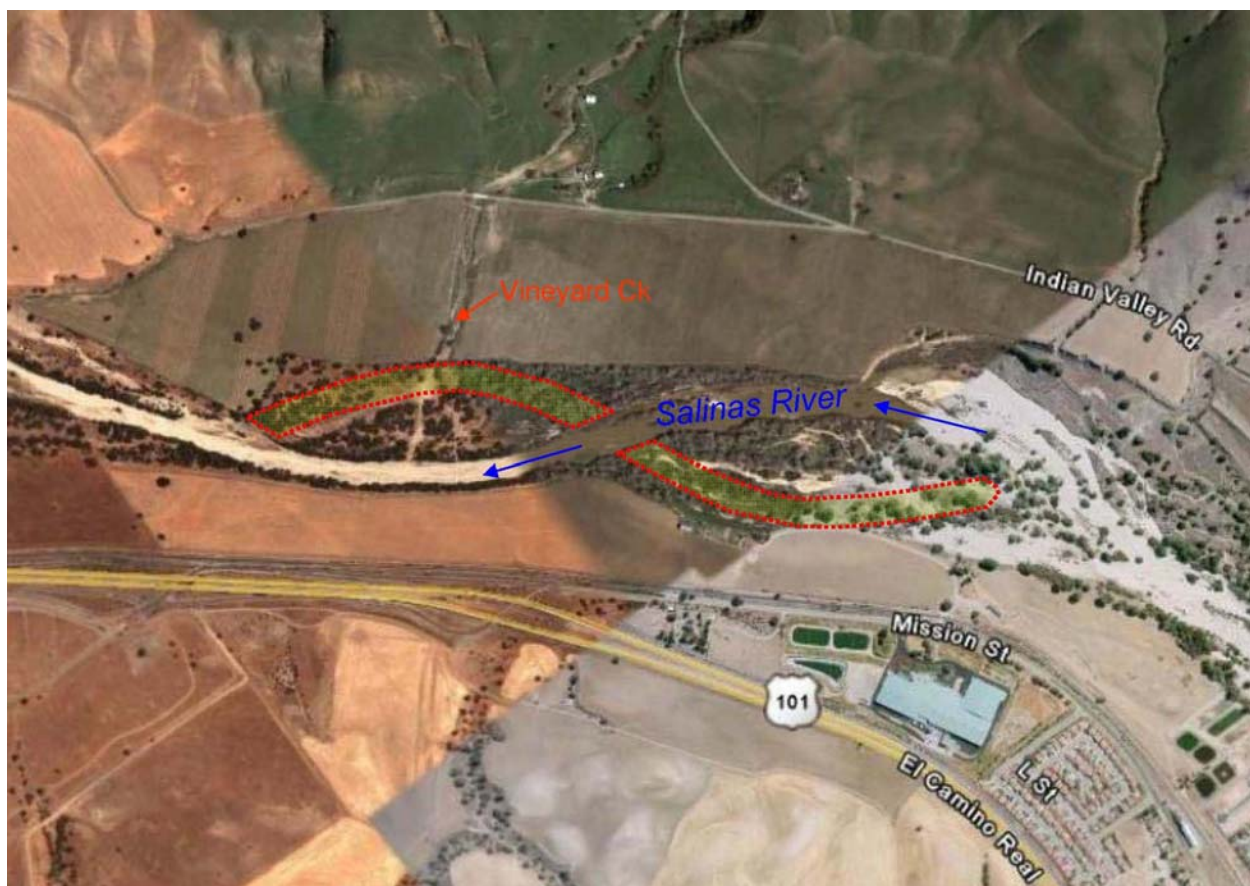


Figure 30. Example excavation area boundary configuration for alternative flood scour channel mimicking bar excavation method.

However, interception of Vineyard Creek flows may cause enough flow to discharge the downstream end of the north floodplain bar excavation trench to cause a nuisance attraction flow for salmonids migrating the Salinas River low-flow channel through the Site. Under existing conditions, the Vineyard Creek tributary discharges over a steep low-flow channel bank that is impassable.

Floodplain bar trenches would receive zero sediment replenishment during most years. The trenches may be significantly replenished during moderate floods which overtop the bar surface for a sustained duration but do not at the same time cause the existing low-flow channel to “capture” the trench. Indeed, the floodplain bar excavation alternative would potentially induce reach-scale low-flow channel switching during a moderate or large flood. If channel switching would not have occurred during the same flood in the absence of the excavated floodplain bar trenches then the Project would potentially have created a significant impact on bank erosion and associated loss of riparian vegetation. This is because channel switching within the Site would require channel switching upstream and downstream from the Site with associated severe bank erosion and losses of existing riparian vegetation occurring on off-Site properties. For more information about historical channel changes at the Site, please see discussion in Section 3. In comparison to the floodplain bar excavation alternative, locating the excavation trenches along the existing low-flow channel alignment minimizes the potential for off-Site bank erosion and riparian vegetation losses.

The floodplain bar excavation alternative would also require significant direct impacts to existing riparian vegetation on the floodplain bar surfaces within the excavation area footprints. The conceptual-level excavation areas shown in Figure 30 comprise a total area of approx. 29 acres, all of which supports existing riparian vegetation.

Where floodplain bar excavation has been successfully implemented for avoiding potential impacts to fish passage (e.g., on the Russian River watershed), the mining has occurred primarily on nearly entirely unvegetated gravel bars, not densely forested floodplain bars like the ones that occur at the Site and within most reaches of the upper Salinas River.

geomorph submits that the Project may have temporary potentially significant impacts on turbidity during fish passage flows, but that these potential impacts will be substantially mitigated in most years of the Project operation by the improvements in hydraulic conditions for fish passage suitability provided by the excavation trenches being narrower than the existing low-flow channel.

5.3 Potential project impacts on the Vineyard Creek corridor

Vineyard Creek drains a 52.3-sq mi portion of the relatively steep foothills deeply dissected in an uplifted mantle of unconsolidated sedimentary rock (Paso Robles Formation) which flanks nearly the entire the eastern edge of the upper Salinas River valley. Minor outcrops of consolidated sedimentary and metamorphic rock have been exposed by complete erosion of the Paso Robles in the highest elevation ridges forming the eastern watershed boundaries. In the upstream portion of the Site, the Vineyard Creek corridor is flanked by oak woodlands generally similar to the oak woodlands occurring in the tributary draws and north-facing slopes uphill from the creek (e.g., Figure 31). Non-native grassland extends down to the edge of the creek bed.

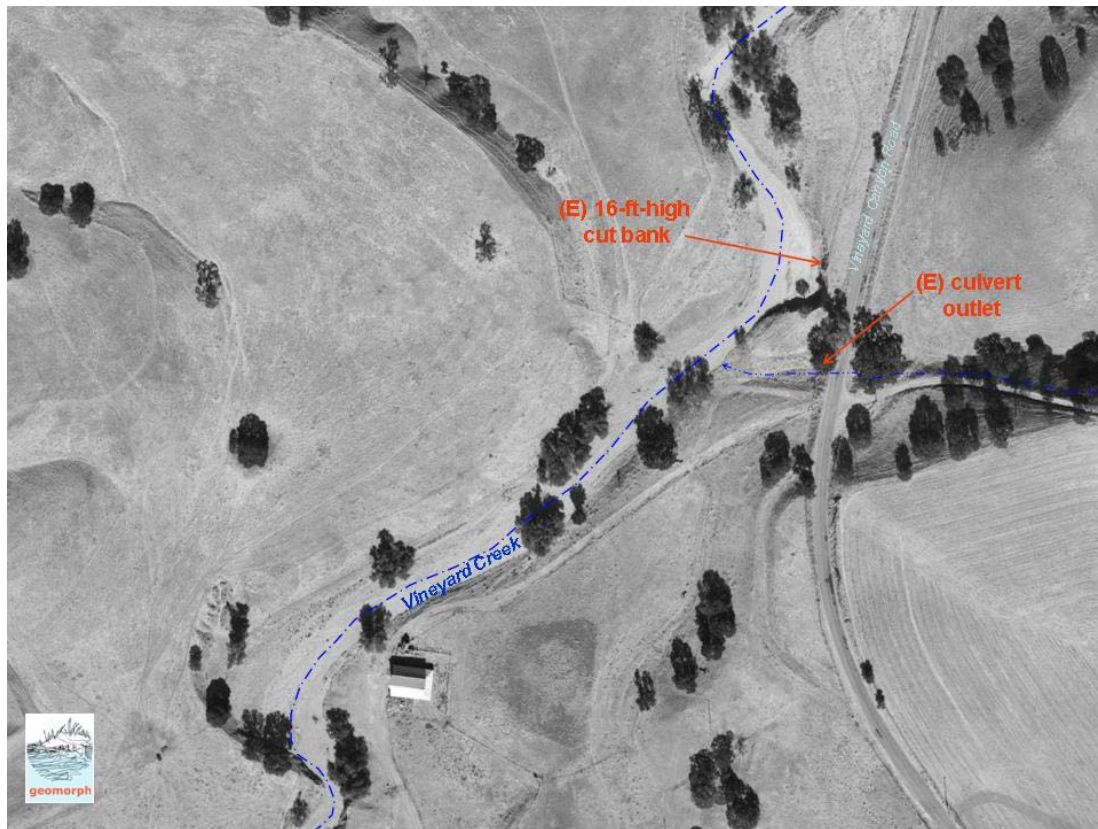


Figure 31. October 19, 2005 air photo of Vineyard Creek corridor centered approx. 2,000 ft upstream from the proposed upstream excavation area limits. Previous proposals had extended the limits upstream to the tributary confluence shown in order to allow for restoring the tributary creek flowline to improve conveyance beneath Vineyard Canyon Road (e.g., see Figure 32), but not upstream from the confluence in order to avoid potential destabilization of the existing 16-ft-high near-vertical eroded channel bank the toe of which is within 22 horizontal feet from Vineyard Canyon Road pavement.

The preliminary sediment budget prepared for the recommended area-wide monitoring and management plan (Section 4) suggests that the annual average natural bedload sediment replenishment to Vineyard Creek is approx. 19,318 CY/yr (Table 2). Therefore, as currently proposed, the Pankey Sand and Gravel Mine project (Project) would extract an annual maximum permitted amount of 9,500 CY/yr from Vineyard Creek. If actual mining occurs at 100% of this annual maximum rate, the Project would allow approx. 51% of the natural bedload supply to bypass the Vineyard Ck excavation area into the upper Salinas River (see Table 5b in Section 6.2). If actual mining occurs at a 50% mining rate, the Project would bypass approx. 75% of the natural bedload supply.

The proposed approx. 3.66-acre excavation area extends 2,460 lineal feet along Vineyard Creek from its outlet at the upper Salinas River floodplain bar surface (approx. elevation 580 ft) to an upstream excavation area limit location designated about 400 ft upstream from the Indian Valley Road Bridge crossing. Figure 4 shows the existing conditions longitudinal bed profile and the proposed redlined excavation trench profile as much as 4-ft below the existing bed elevation. Sheet C-4 in Appendix A also shows the existing and redlined channel bed elevation profiles and the proposed excavation area boundaries, operations/stockpile areas, and haul roads overlain on air photos of the Site. Figure 31 and Figure 32 show the existing corridor conditions approx. 2,000 ft upstream from the proposed excavation area limit.

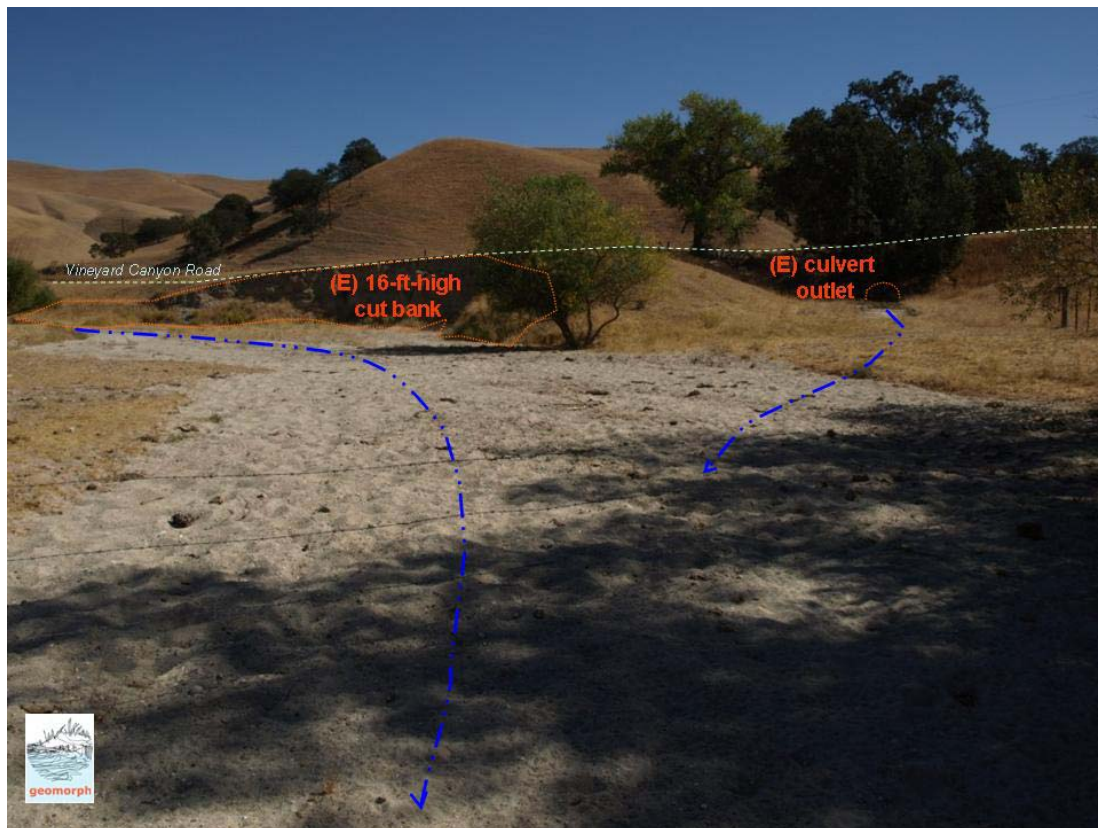


Figure 32. View looking upstream to Vineyard Creek approx. 2,000 ft upstream from the proposed upstream excavation area limits. Previous proposals had extended the limits upstream to the tributary confluence shown in order to allow for restoring the tributary creek flowline to improve conveyance through the existing culvert running beneath Vineyard Canyon Road, but not upstream from the confluence in order to avoid potential destabilization of the existing 16-ft-high near-vertical eroded channel bank the toe of which is within 22 horizontal feet from Vineyard Canyon Road pavement (Photo October 15, 2008).

Previous versions of the proposed Vineyard Creek excavation plan had extended the excavation area this far upstream so as to allow drainage improvements for the plugged tributary culvert running beneath Vineyard Canyon Road, and downstream from the existing 16-ft-high near vertical channel bank to avoid destabilizing it. Figure 32 shows the conditions in the vicinity of the confluence with the plugged culvert tributary. These culvert capacity improvements have been eliminated from the Project because the proposed annual maximum extraction rate has been reduced from 20,000 CY/yr to 9,500 CY/yr for meeting the 50% bedload supply bypass objective at the Vineyard Creek watershed outlet.

Sequential air photos and field observations of sedimentation within the Vineyard Creek Canyon Road culvert and the Indian Valley Road Bridge suggest that the downstream reach of Vineyard Creek within the Site has recently aggraded. Aggradation is generally corroborated by the general watershed-scale findings of Watson et al. (2003) – tributary streams on the east side of the Salinas River watershed have been aggrading at approx. 0.5-1.5 ft per decade. This trend is unrelated to bed elevation changes on the receiving Salinas River. Watson et al. (2003) suggested that the higher than expected sediment yields from the dryer east-side tributaries were the result of tectonic influence of the San Andreas Fault zone, particularly within the highest elevation reaches of the tributaries closer to the fault zone. Accordingly, an ancillary purpose of the proposed Vineyard Creek excavation is to formalize and make more effective an already ongoing effort to remove

sediment from bed in the vicinity of the Indian Valley Road Bridge where the bed has again risen to within two vertical feet from the bridge low chord. Recall from the historical geomorphic analysis (Section 3) that the bridge was destroyed by the 1969 flood. The existing bridge was constructed shortly after the 1969 flood.

As proposed, the Project would in the first year of operation excavate the Vineyard Creek bed to approx. 4 ft below existing bed grade at and within 400 ft upstream and downstream from the bridge roadway centerline to substantially restore bridge design conveyance and at the same time maintain sufficient cover for the existing bridge abutment footings. Please see Sheet C-4 in Appendix A for a design section at the Indian Valley Road Bridge.

Elsewhere throughout the excavation area the first year and subsequent year maximum excavation depth is 3 ft. During the Project lifetime, excavation would never occur below the 'redline' trench bed elevation set uniformly 4 ft below the existing bed grade at the time the Project begins. Excavation would also never occur within 1 vertical ft from the then existing groundwater table. However, summer-fall groundwater table measurements from existing wells near the upstream end of the site indicate that the groundwater table is typically several or more feet below the proposed 4-ft-deep redlined trench bed. October 2008 pit well measurements on the Salinas River bed at the Vineyard Creek confluence reported by SDC (2008) indicate that the summer-fall groundwater table is similarly more than several feet below the proposed redlined trench bed near the downstream end of the excavation area.

The excavation area limits would be subject to similar horizontal and vertical setbacks as the north and south excavation areas within the Salinas River:

- minimum 25-ft horizontal setback from property boundaries;
- minimum 10-ft horizontal setback from existing toe of bank and riparian tree driplines, whichever is greater;
- maximum 3H:1V trench side slopes;
- maximum 4H:1V trench head slopes;
- maximum 3-ft annual total excavation depth (except within 400 ft from the Indian Valley Road Bridge roadway centerline as necessary to maintain the flood control target 604 ft bed elevation beneath the bridge);
- maximum 4-ft total excavation depth (redline depth) below existing bed grade at the beginning of Project; and,
- 1-ft vertical buffer between excavation and groundwater table.

The attached preliminary excavation plan drawings (Appendix A) show these proposed setbacks applied to existing current existing conditions property boundary, site topography, and tree dripline data. These plans are detailed to the conceptual design level appropriate for permit review submittal purposes. The actual excavation plan would be developed when the Project is permitted and determined according to both the required mining limitations listed in the Permit Conditions and then existing conditions prior to the first year of mining.

Special excavation area design rules would apply to the downstream end of the proposed Vineyard Creek excavation area. The downstream end of the excavation area follows the existing Vineyard Creek bed from the Salinas River terrace surface over the steeply sloping alluvial fan surface, thence onto and over the Salinas River floodplain bar surface before discharging into the River over the Salinas River low-flow channel bank. SDC (2008) proposed sloping the downstream most 400-ft-long section of Vineyard Creek at a slope of 400H:12V (3%) in order to smoothly meet the mining-reduced Salinas River bed elevations within the south excavation area. Inspection of existing grades shown in Figure 26 and Sheet C-4 in Appendix A shows that doing so would require the Vineyard Creek bed to be excavated as much as 6-8 ft below existing grade over a short section. As shown in Figure

30 and Sheet C-4, the existing channel bed is relatively narrow in this section of Vineyard Creek. It may be impossible to provide for the 6-8-ft lower bed elevation while also adhering to the required minimum 10-ft setbacks from the existing bank toes and maximum finished 3H:1V side slopes. To avoid and minimize potential impacts on bank erosion and associated loss of existing riparian vegetation, **geomorph** revised the Vineyard Creek trench channel invert grading so that it daylights at the existing Vineyard Creek bed grade of elevation approx. 580 ft where the existing channel is inset within the Salinas River floodplain bar surface by only approx. 3 vertical feet. As shown in Sheet C-4, this would require no modifications to the lower 200 ft of existing Vineyard Creek. The 400-ft-long section of Vineyard Creek beginning 200 ft upstream from its existing outlet would need to be graded at a uniform 1% slope from existing bed elevation 580 ft at approximately Station 5+90 to Station 6+10 to proposed redline trench bed elevation 584 ft at Station 9+90 to 10+10.

As proposed, the Project would have no potential impacts to groundwater or fish passage. The summer-fall groundwater table is reliably well below the proposed redline trench floor elevation. Fish do not pass from the Salinas River into Vineyard Creek under existing conditions, and would not pass into Vineyard Creek under proposed conditions.

By lowering the low-flow channel bed elevation along the length of the excavation area, the Project would have potential impacts to bank erosion and associated riparian vegetation. These impacts would be substantially avoided and minimized by configuring the excavation area limits to avoid existing channel banks and riparian tree drip lines by minimum 10 horizontal feet and with maximum 3H:1V trench side slopes. As described above, the excavation area limits have been designated at both the upstream and downstream ends of the excavation area to transition into existing grade in a manner that substantially avoids and minimizes the potential for bank erosion and riparian vegetation losses according to found field conditions. **geomorph** finds 10-ft minimum horizontal setbacks from existing channel bank toes and existing riparian tree driplines, whichever is greater, to be generally sufficient for avoiding and minimizing potential Project impacts on bank stability and associated loss of riparian vegetation along the Vineyard Creek corridor. Still, in general, because bank erosion is a natural process it should be difficult in practice to isolate and attribute increments of bank erosion to the effects of the mine trenches, particularly following moderate or large floods when there is substantially greater potential for both mining-influenced and natural bank erosion. **geomorph** recommends that the recommended S-1 Monitoring Plan (Section 6) include expert repeat field inspections and observations to detect excessive bed elevation changes or abnormally rapid bank erosion along and upstream and downstream from the Vineyard Creek excavation area. According to the recommended S-1 Monitoring Plan, the County-appointed S-1 Environmental Monitor would use repeat measured spot elevation monitoring data, repeat field photos from fixed monitoring viewpoints, and professional judgment to recommend adaptive management of the Vineyard Creek excavation plan, including revisions in the horizontal setbacks needed to reduce erosion pressure at specific locations, delays or reductions in mining, or physical bank and vegetation restoration work as needed to mitigate for the portion of any identified accelerated bank erosion and associated riparian vegetation loss attributed to the effects of the Project.

geomorph submits that the Project will have a temporary less than significant impact on fluvial geomorphology, groundwater, and riparian vegetation of Vineyard Creek.

5.4 Cumulative Impacts

As discussed in Section 4 and elsewhere in this Plan, the Project may have cumulative impacts on the fluvial geomorphology, groundwater, and riparian vegetation of the upper Salinas River in the Project vicinity which may be potentially significant if not appropriately mitigated. This is because there are numerous existing active and proposed instream mines upstream from the Site that remove sediment from the system and reduce the natural bedload replenishment rate at the Site. In so far as these projects cumulatively further reduce the upper Salinas River channel bed elevations within and near the site compared to the effects of the Pankey project alone, then there is a potential for cumulative impacts to occur. These would be the same as the indirect effects of bed elevation decline within and near the site described in Section 5.2, but possibly more significant and less temporary.

geomorph recommends the following two measures for avoiding, minimizing, and mitigating the potential cumulative impacts of the Project:

- (1) Completing a watershed-scale sediment budget analysis for determining the estimated average annual bedload sediment replenishment rate at the Site that reflects the influence of extractions made at the existing permitted and proposed upstream from the Site. The Project should then be conditioned to annually extract not more than 50% of the estimated mining-reduced supply at the Site so as to allow minimum sediment 50% bypass. Section 4 presents a preliminary sediment budget.
- (2) Implementing a reach-scale state-of-the-art monitoring plan that requires a County-appointed expert Environmental Monitor to make semi-annual site inspections to compile, confirm, and report the cumulative bed elevation and groundwater table monitoring data, identify and discuss general compliance or violations of the specific permit conditions, and recommend adaptive changes to the excavation plan and permit conditions deemed necessary to avoid, minimize, and mitigate for Project impacts. Section 6.5 presents the recommend S-1 Monitoring Plan.

***geomorph** submits that limiting the Project's total annual maximum permitted extraction rate to allow 50% bypass of the average annual bedload sediment replenishment rate to the Site estimated in Section 4, and implementing the recommended S-1 Monitoring Plan described in Section 6.5 would adequately avoid, minimize, and mitigate for the Project's potential cumulative impacts.*

6. AREA-WIDE ADAPTIVE MANAGEMENT PLAN

6.1 Introduction

This Area-Wide Adaptive Management Plan (Plan) is initiated first and foremost for evaluating the potential cumulative impacts of the proposed Pankey Sand and Gravel Mine Project (Project) near San Miguel in the watershed-scale context of ongoing existing permitted instream mines and other currently proposed new instream mines. Toward this end, **geomorph** developed an existing conditions bedload sediment budget for the 30.22-mi-long alluvial mainstem upper Salinas River in San Luis Obispo County (see Table 4c in Section 4). The preliminary sediment budget first estimates the natural bedload sediment supply to the downstream ends of each of five geomorphic subreaches and the Pankey Site locations in Reach S-1. The budget then estimates how much the existing permitted instream mines reduce the actual sediment supply to these locations (existing conditions). To substantially protect the river from environmental impacts, the Resource Agencies recommend and this Plan generally adopts the planning goal of conditioning instream mines to allow 50% of the estimated natural bedload sediment supply pass through, or bypass, individual mine sites and larger geomorphic subreaches (e.g., NOAA 2004). It is believed that management achieving 50% bypass through all of the individual geomorphic subreaches and individual instream mine sites would substantially avoid and minimize cumulative impacts of sand and gravel mining on the upper Salinas River environmental resources.

The existing conditions sediment budget (Table 4c) indicates that after the existing permitted instream mines have made just 50% of their annual maximum permitted extractions there is not enough natural bedload sediment supply remaining on the upper Salinas River to permit all of the new instream mines as proposed while still achieving 50% bypass. Section 6.2 below details the limitations of the existing conditions sediment supply for permitting the three proposed new instream mines located on the mainstem river.

For planning information purposes, Section 6.3 extends the area-wide sediment budget analysis for summarizing what changes to the current amounts and distribution of permitted maximum mining extraction would be needed to achieve 50% bedload sediment bypass on all of the individual geomorphic subreaches comprising the 30.22-mi-long alluvial upper Salinas River in San Luis Obispo County. This hypothetical analysis provides a tool for envisioning what future changes to the pattern of mining in the watershed can be made to simultaneously achieve avoidance of cumulative impacts through continuous 50% bedload bypass and meet the local economy's projected future increased demand for sand and gravel construction material.

Section 6.4 outlines general administrative and technical recommendations for implementing an area-wide adaptive management monitoring plan covering the entire length of the upper Salinas River.

And Section 6.5 outlines procedures for the S-1 Monitoring Plan recommended for mitigating for potential direct and cumulative impacts of the Pankey Project on the Site and upstream and downstream reaches comprising the larger S-1 subreach as well as Vineyard Creek tributary to S-1. The recommended S-1 Monitoring Plan is considered a template for applying to the other instream mine sites and subreaches as part of the recommended area-wide monitoring and management plan.

6.2 Existing sediment supply limitations for permitting proposed new instream mines

As reviewed in Section 4.3, there are currently four proposed new instream mines in the upper Salinas River watershed. One of the proposed new instream mines is a relatively small stock pond dredging project proposed on San Marcos Creek tributary to Reach S-2, and is not evaluated here because it is deemed small enough to have a negligible impact on the upper Salinas River sediment budget. Three of the proposed new instream mines are relatively large operations at mainstem river locations in Reaches S-2 and S-1 (Figure 33). As currently proposed, the new Pehl and Weyrick instream mines would together remove as much as 120,000 CY/year of bed material from Reach S-2. As proposed, the new Pankey instream mine would remove as much as 96,000 CY/yr of bed material from the upper Salinas River and 9,500 additional CY/yr from tributary Vineyard Creek (1055,500 CY/yr total).

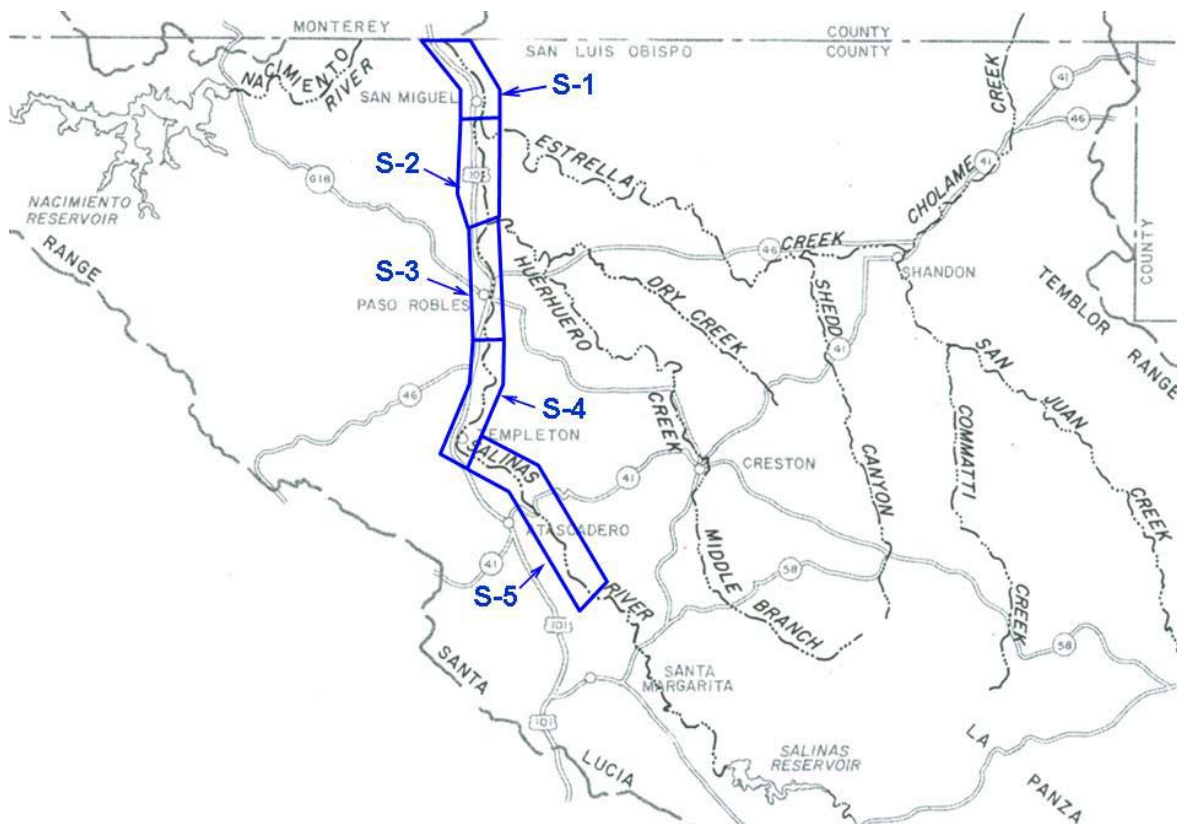


Figure 33. Geomorphic subreaches comprising the entire 30.22-mile-long alluvial portion of the mainstem upper Salinas River within San Luis Obispo County potentially subject to cumulative impacts of multiple existing permitted and proposed new instream mines. The proposed new Pehl and Weyrick instream mines are located in S-2 and the proposed new Pankey instream mine is in S-1.

Table 5a shows estimated mining-reduced sediment supplies and percent bypass at the downstream ends of the individual geomorphic subreaches and at the Pankey Project locations assuming all of the existing permitted mines extract sediment at 50% of their

annual permitted maximum extraction rates and all 3 of the proposed new instream mines extract sediment at 100% of their current proposed annual maximum extraction rates. If both the Pehl and Weyrick mine projects are permitted as currently proposed, they would reduce the Reach S-2 bedload sediment bypass by 120,000 CY/yr from (+) 45,167 CY/yr (Table 4c) to (-) 74,833 CY/yr, and reduce the percent sediment bypass from (+) 29% (Table 4c) to (-) 48%. The Pehl and Weyrick mines would also reduce the Reach S-1 sediment bypass by 120,000 CY/yr, from 389,576 CY/yr (Table 4c) to 269,576 CY/yr. The Pehl and Weyrick projects would reduce the percent sediment bypassing Reach S-1 from 75% (Table 4c) to 52%. If, in addition, the Pankey Project is permitted as currently proposed, it would reduce the S-1 sediment supply by an additional 105,500 CY/yr from (+) 269,576 CY/yr to (+) 164,076 CY/yr (Table 5a), further reducing the S-1 bypass from 52% to 31% (Table 5a).

Table 5a.
Proposed Conditions

Estimated mining-reduced bedload replenishment rates to the
individual geomorphic subreaches of the mainstem upper Salinas River

Scenario 1:

Assuming proposed new Pehl, Weyrick, and Pankey mines are all permitted as currently proposed.

50% Mining Rate Assumption for existing mines

100% Mining Rate Assumption for proposed new mines

		Existing	Proposed	Total	50%	Cumulative	
	Natural	Mines	Mines	Mines	Cumulative	Mining-	
	Annual	Annual	Annual	Annual	Annual	Reduced	
	Average	Maximum	Maximum	Maximum	Maximum	Average	
	Bedload	Permitted	Permitted	Permitted	Permitted	Bedload	Percent
	Supply	Extraction	Extraction	Extraction	Extraction	Bypass	Bypassed
	(CY/yr)	(CY/yr)	(CY/yr)	(CY/yr)	(CY/yr)	(CY/yr)	(%)
Subreach							
Reach S-5	51,980	50,000	0	50,000	25,000	26,980	52%
Reach S-4	94,198	95,000	0	95,000	72,500	21,698	23%
Reach S-3	109,012	75,000	0	75,000	110,000	-988	-1%
Reach S-2	155,167	0	120,000	120,000	230,000	-74,833	-48%
Reach S-1	522,076	45,000	105,500	150,500	358,000	164,076	31%
<i>Subtotals:</i>		265,000	225,500	490,500	358,000		
Other Locations							
Pankey Site	521,499	0	105,500		358,000	163,499	31%
Vineyard Ck	19,318	0	9,500		9,500	9,818	51%
<i>Subtotals:</i>		0			358,000		

Notes

Viborg-Estella mine (45,000 CY/yr) included in cumulative totals for Reach S-1 and Pankey Site.

As proposed, Pankey Project would extract 125,000 CY/yr from Salinas River and 10,000 CY/yr from Vineyard Ck; 135,000 CY/yr total.

Extraction from Vineyard Creek included in cumulative totals for Reach S-1 and Pankey Site.

100% mining rate assumed for proposed new mines in S-2 (Pehl and Weyrick) and S-1 (Pankey).

Table 5a shows that it would not be possible to permit all three of the new instream mines as they are currently proposed in Reach S-2 and Reach S-1, while at the same time providing for 50% bypass of the natural bedload sediment supply. Moreover, the resulting estimated (-) 74,833 CY/yr sediment deficit in Reach S-2 is large enough to cause river bed degradation. Applying the same mass-balance reasoning as described above for the 6.48-mile-long Reach S-3 to the 5.02-mile-long Reach S-2, the resulting deficit would cause up to 0.38 ft/yr of channel bed elevation decline on Reach S-2.

An alternative scenario assumes that the proposed new Pehl, Weyrick, and Pankey mines would be permitted at annual maximum extraction amounts reduced from their current proposals so as to require 50% bypass for all of the affected individual geomorphic subreaches and mine site locations (Table 5b).

Table 5b.
Proposed Conditions

Estimated mining-reduced bedload replenishment rates to the
individual geomorphic subreaches of the mainstem upper Salinas River

Scenario 2:

Assuming proposed new Pehl, Weyrick, and Pankey mines are all permitted to require 50% bypass.

50% Mining Rate Assumption for existing mines

100% Mining Rate Assumption for new mines

		Existing	Proposed	Total	50%	Cumulative	
	Natural	Mines	Mines	Mines	Total	Mining-	
	Annual	Annual	Annual	Annual	Annual	Reduced	
	Average	Maximum	Maximum	Maximum	Maximum	Average	
	Bedload	Permitted	Permitted	Permitted	Permitted	Bedload	Percent
	Supply	Extraction	Extraction	Extraction	Extraction	Bypass	Bypassed
	(CY/yr)	(CY/yr)	(CY/yr)	(CY/yr)	(CY/yr)	(CY/yr)	(%)
<u>Subreach</u>							
Reach S-5	51,980	50,000	0	50,000	25,000	26,980	52%
Reach S-4	94,198	95,000	0	95,000	72,500	21,698	23%
Reach S-3	109,012	75,000	0	75,000	110,000	-988	-1%
Reach S-2	155,167	0	0	0	110,000	45,167	29%
Reach S-1	522,076	45,000	105,500	150,500	238,000	284,076	54%
<i>Subtotals:</i>		265,000	105,500	370,500	238,000		
<u>Other Locations</u>							
Pankey Site	521,499	0	105,500		238,000	283,499	54%
Vineyard Ck	19,318	0	9,500		9,500	9,818	51%
<i>Subtotals:</i>		0			238,000		

Notes

Viborg-Estrella mine (45,000 CY/yr) included in cumulative totals for Reach S-1 and Pankey Site.

As proposed, Pankey Project would extract 125,000 CY/yr from Salinas River and 10,000 CY/yr from Vineyard Ck; 135,000 CY/yr total.

Extraction from Vineyard Creek included in cumulative totals for Reach S-1 and Pankey Site.

100% mining rate assumed for proposed new mines in S-2 (Pehl and Weyrick) and S-1 (Pankey).

Table 5b shows estimated mining-reduced percent bypass for proposed conditions assuming all three of the proposed new mainstem instream mines extract sediment at annual maximum rates reduced from their current proposed rates so far as to provide 50% sediment bypass for individual reaches and site locations. The so reduced annual maximum extraction rates are shown in green. The proposed Pehl and Weyrick mines would need to reduce their proposed extraction rate to zero because Reach S-2 already bypasses less than 50% of its estimated natural bedload sediment supply under existing conditions. The Pankey Project, as currently proposed to extract an annual maximum of 105,500 CY/yr, would provide for 51% bypass on Vineyard Creek and 54% bypass on Salinas Reach S-1.

6.3 Required changes to current instream mining pattern to create continuous 50% bedload sediment bypass along the entire upper Salinas River corridor

Section 6.2 provides an example for how the existing conditions sediment budget developed in this Plan (Table 4c) can be used to determine annual maximum permitted extraction rates for the new proposed instream mines for maintaining 50% bedload sediment bypass through the affected sites and mainstem reaches. Achieving 50% bypass in Reach S-4, Reach S-3, and Reach S-2 will require reducing over time the total annual maximum permitted extraction from the six existing instream mines in Reach S-4 and Reach S-3 (Table 3), some of which may be vested. Assuming 50% mining rate, the total annual maximum permitted extraction from the 4 existing instream mines in Reach S-4 will need to be reduced approx. 50,000 CY/yr, from 95,000 CY/yr to approx. 45,000 CY/yr. Extraction from the 3 existing instream mines in Reach S-3 (all in City jurisdiction) will need to be reduced approx. 60,000 CY/yr, from 75,000 CY/yr to approx. 15,000 CY/yr. Accomplishing the above reductions over time through the permit renewal process and permitting the 3 proposed new instream mines in Reach S-2 and Reach S-1 to require minimum 50% sediment bypass in those subreaches together would achieve 50% sediment bypass in all of the subreaches comprising the 30.22-mile-long alluvial upper Salinas River in San Luis Obispo County.

Providing for 50% bypass on Reach S-4 and Reach S-3 would produce a 23,000 CY/yr “surplus” on Reach S-2. That is, a new instream mine could then be permitted on Reach S-2 that would extract 23,000 CY/yr (100% mining rate assumption) while still providing minimum 50% sediment bypass. Assuming then that Reach S-2 bypasses 50% sediment, there is also a 54,500 CY/yr “surplus” on Reach S-1. Existing instream mine(s) could be expanded or new instream mine(s) permitted on Reach S-1 or on the Estrella River that would extract an additional annual maximum amount of 54,500 CY/yr (100% mining rate assumption) while still providing minimum 50% sediment bypass.

Overall, achieving continuous 50% bypass along the entire upper Salinas River corridor would require redistributing the current pattern mining so that it is not concentrated in individual geomorphic subreaches, as it is under existing conditions. It would require reducing the mining occurring in and upstream from Paso Robles, which would in turn allow increases in mining downstream from Paso Robles. In the interim, the current concentration of permitted mines in and upstream from Paso Robles limits the amounts that can be mined from Reach S-2 and Reach S-1 (see Section 6.2).

This Plan can be used this way as a technical basis for current and future permitting processes in implementing an Area-Wide Monitoring and Management Plan for ensuring sustainable development of the existing sand and gravel resources to meet future increased

demand for construction materials while substantially protecting the environmental resources of the upper Salinas River corridor.

6.4 Implementing an Area-Wide Monitoring and Management Plan

The underlying philosophy of the recommended area-wide monitoring plan is that an analytical sediment budgeting approach is unsatisfactory as the only means for estimating the sustainable instream mining sediment extraction rate for the upper Salinas River Watershed. This is because natural sediment yield estimates require extrapolation of relatively few real measurements of sediment transport and storage, often from other watersheds and time periods. Indeed, the Resource Agencies have repeatedly expressed concerns about how best to accurately estimate sediment supply estimation on the upper Salinas River watershed. There are also concerns about how the interannual variability of sediment supply in a Mediterranean or Sonoran watershed affects the year-to-year applicability of maximum mine extraction rates conditioned on the annual average sediment supply.

Instead, by more rigorously monitoring real fluctuations of bed elevations and the shallow groundwater table, and better tracking streambank erosion patterns in the vicinity of individual mines, consistent format annual reports would establish a baseline condition and build reliable long-term trend exhibits that will both ensure resource managers and policy makers that the then current actual sediment extraction rate is either sustainable or not, and underpin a sound technical basis for evaluating future permit applications for new instream mines.

By employing repeat airborne digital air photo and topographic data collection (e.g., LiDAR), the Plan would develop orthorectified digital air photos overlain by 1-ft contour interval digital topographic maps of the upper Salinas River riparian corridor from which bed elevation changes can be routinely measured for the entire longitudinal profile. CAD-enabled volumetric measurements can also be made to track changes in bed sediment storage in the system and calculate actual replenishment rates. These data combined with operator-reported extraction rates provide a basis for assembling a real-data sediment budget for the system.

The primary focus of the Area-Wide Plan would be on tracking future trends in bed elevation and shallow groundwater table elevations along the length of the mainstem upper Salinas River compared to existing conditions (baseline). Secondly, what historical bed elevation and groundwater table elevation data can be obtained from historical records, maps, bridge, stream gage, and instream mine monitoring reports can be assembled for looking at recent historical trends leading up to the baseline condition. Valuable insights into the resilience of the upper Salinas River system will be gained through understanding what effects existing active instream mines have had on bed elevations over the past several decades.

High-resolution digital color orthophotos combined with 1-ft topographic data produced by LiDAR would be ideal for tracking bed elevation changes and bank erosion system-wide and in the vicinity of instream mines. These LiDAR data would also provide excellent existing conditions site plan data for any project contemplated within the riparian corridor, including streambank stabilization, flood control, river restoration, mine reclamation, bridge and pipeline construction and monitoring.

LiDAR data collection would extend from bed elevation monitoring already presumably occurring at existing instream mines. That is, typical monitoring requires repeat channel

cross-section surveys once or twice each year at fixed locations in the mine vicinity. Cross-sections are surveyed on the ground between monumented cross-section endpoints, typically concrete, steel, or wood stakes. By adding permanent air photo targets to the cross-section endpoint monuments and temporary targets at temporary surveyed control points on the river bed, these routine monitoring cross-section surveys already being implemented by existing mine operators will create part of the pre-flight ground elevation control needed for LiDAR topographic data calibration. These routine monitoring cross-section surveys can also be used by the TAC to determine when and where bed elevation changes are significant enough to warrant repeating LiDAR data collection for the subreach.

Recommended Technical Advisory Committee

Experts are needed to quickly and meaningfully interpret and summarize field observations and monitoring data in annual reports for resource managers and policy makers. In the years when bed elevation and shallow groundwater table declines and/or potentially mining-influenced bank erosion are detected by the field or remote sensing aspects of the monitoring, expert evaluation will be needed to decide if the bed elevation declines are severe enough to require temporary mining limitations for preventing damage to environmental resources. Experts will also be needed to differentiate between mining-induced and natural to-be-expected bank erosion and prescribe appropriate mitigation measures, such as bank stabilization and revegetation. After having implemented the Area-Wide Plan for several years, TAC members can cost-effectively and reliably make concise recommendations to policy makers and resource managers.

Other successful aggregate resources management plans [e.g., Cache Creek Resources Management Plan (CCRMP), Yolo County, County of Humboldt Extraction Review Team (CHERT), Humboldt County] have relied on 3-4 person TACs comprised of engineers, geomorphologists, riparian ecologists, and fish biologists, etc. Three CCRMP TAC members are appointed by the Yolo County BOS to serve three-year terms. The CCRMP TAC monitors the effects of instream and floodplain mines and evaluates and comments to any project proposed in the Cache Creek riparian corridor. The TAC decides when and where to obtain new LiDAR data and oversees implementation of multi-disciplinary studies of the riparian corridor to meet changing needs. Four CHERT members are appointed by the Humboldt County BOS to make bi-annual inspections and cross-section surveys of individual mine sites. Each year CHERT and mine operators negotiate a mutually agreed-upon mining plan or excavation design for each individual mine site, based on that year's actual field observed and measured replenishment and other factors. CHERT makes follow up inspections after the mining season to survey cross-sections and document compliance with that year's agreed-upon mining design plan.

A multiple-person TAC is recommended for implementing an area-wide monitoring plan for the upper Salinas River. The recommended S-1 Monitoring Plan for the Pankey Sand and Gravel Mining Project outlined in Section 6.5 would cover only the 4.5-mile-long S-1 Reach. With its smaller geographic scope, S-1 monitoring could be implemented by a single County-appointed monitor. By implementing the S-1 Monitoring Plan in advance of the area-wide monitoring plan, the S-1 monitor could later advise the County in adapting the S-1 monitoring plan methods to the other subreaches and assembling a suitable TAC for implementing the larger area-wide plan.

Other suggestions for implementing an area-wide monitoring plan are compiled in Appendix K.

6.5 S-1 Monitoring Plan

The recommended S-1 Monitoring Plan for the Pankey Sand and Gravel Mining Project outlined in this section would monitor environmental conditions along the entire 4.5-mile-long S-1 Reach of the upper Salinas River extending from the San Luis Obispo County Line on the north (RM 109.00) to the Estrella River confluence on the south (RM 113.5) (Figure 34).

When implemented, this S-1 Monitoring Plan can be used as a template for conducting similar monitoring on the other subreaches of the upper Salinas River. As conceived by this Plan, such an area-wide monitoring plan would be conducted by a Technical Advisory Committee (TAC) comprised of County-appointed professional consulting engineers, geomorphologists, and restoration ecologists. The TAC would produce consistent format annual reports to the County of San Luis Obispo and others describing year-to-year and ongoing long-term trends in river bed elevations, instream sediment storage, sediment replenishment, sediment extraction, shallow groundwater table elevations, bank erosion, and impacts to riparian vegetation. Annual monitoring reports would include overall summary expert analysis, individual site-specific observations, and recommendations by the TAC for adjusting sediment extraction rates and requiring restoration work as needed to avoid and mitigate mining impacts on the environment. Over time the accumulating “system-wide” monitoring data would supplant the analytical sediment budgeting approach for determining if total sediment extraction from the system or individual subreaches is exceeding supply. Common sense data summaries afforded by the Plan would provide resource managers and policy makers with a clear and unambiguous basis for collectively evaluating the overall sustainability of instream mining and assessing the general physical condition of the upper Salinas River as an environmental resource.

The approx. 2,000 sq mi upper Salinas River watershed area includes the reservoir regulated Nacimiento River watershed area which discharges to the Salinas River near the head of the canyon reach about 3.4 river miles downstream from the County Line. To encompass the entire downstream section of the upper Salinas River, the S-1 Monitoring Plan would also periodically survey bed elevations and channel changes at the Southern Pacific Railroad Bridge (RM 106.15) about half-mile upstream from the Nacimiento River confluence. The San Miguel Bridge (RM 112.6) occurs in Reach S-1. No cross-channel pipelines are known to exist in Reach S-1. The State of California Big Sandy Creek Refuge lies downstream from and slightly overlaps Reach S-1.

There are none currently active instream mines in Reach S-1. There is one currently pending application for a new instream mining operation on the Salinas River and tributary Vineyard Creek (proposed Pankey Sand and Gravel Mine). As currently proposed, the Pankey mine would extract as much as 125,000 CY/yr of bed material from the Salinas River bed and as much as approx. 10,000 CY/yr from Vineyard Creek.

A Condition of Approval of the Pankey Project will be that the Operator will fund the completion of the following tasks by County-appointed Environmental Monitor under the supervision of the area-wide monitoring plan TAC, if and when it is established: (1) Monitor Salinas River bed and shallow groundwater table elevations and bank erosion on Reach S-1 including LiDAR data collection; and, (2) implement Project Site monitoring for complying with permitted mining setbacks and limitations.

First Year Pre-Excavation Monitoring Procedure

Mining will occur only under dry channel bed conditions. Prior to the first season of mining, the Operator will complete the following:

1. Establish expanded permanent survey control benchmark network in NAD83 UTM horizontal datum and NAVD88 vertical datum. Use traditional digital theodolite surveying and/or survey-grade GPS to expand the existing survey control network established on site in 2005 to provide additional permanent monuments:
 - a. Monitoring cross-section endpoints on terrace surfaces on either side of the Salinas River riparian corridor for not less than 20 total cross-sections spaced approx. 1,000 ft apart beginning approx. 500 ft downstream from the Big Sandy Creek confluence and extending upstream to San Miguel Bridge. Fix permanent-type air targets to the cross-section endpoints.
2. Install groundwater monitoring piezometers in an array comprising not less than six (6) along the east bank of the Salinas River from near the downstream end of the proposed North Excavation Area to near the upstream end of the proposed South Excavation Area, such that the average spacing between piezometers is not more than approx. 2,000 ft. Use 3-4-inch diameter PVC casing screened at a range of depths corresponding to approx. 0-10 ft below the adjacent river bed elevation. Install piezometers as close as practically feasible to the low-flow channel of the Salinas River, recognizing that piezometers within the riparian corridor will be subject to replacement if scoured by floods. Survey location and elevation of finished grade at top of piezometer casing relative to permanent survey monuments established in 1. Being logging monthly measurements of depth to groundwater table (ft) and groundwater table elevation (ft NVD88).
3. Construct ingress/egress haul roads, operations/stockpile areas, and access routes.
4. Field survey baseline existing conditions at all of the 20 monitoring cross-sections. Collect existing conditions channel bed, bank, and bar surface profile data at a level of accuracy similar to geomorphic cross-section surveys. For example, collect data points at breaks and slopes and otherwise at intervals so that the elevation points area spaced not more than 50 ft apart on average, and may be as little as 5 ft apart in areas with complicated terrain. Also establish temporary cross-section endpoint markers at top of bank locations on either side of the active low-flow channel to facilitate future truncated surveys and spot elevation checks, as may be applicable after intervals of minimal channel change when surveying the entire section between permanent cross-section endpoint monuments would not provide additional useful data. Fix temporary air targets to these intermediate temporary cross-section endpoints. Also fix temporary air targets to at least 1 location on the river bed near each cross-section and survey that location/elevation. All air targeted survey points should be coded to allow stratification and exporting for LiDAR data calibration purposes.
5. Collect via LiDAR digital orthophotos and 1-ft contour interval digital topography for Subreach S-1. Requires establishing surveyed air target ground control in addition to ground control established in items 1.(a) and 4. above, as determined necessary according to TAC in consultation with LiDAR contractor.
6. Determine project maximum depth (redline) elevations at the site for observation during the remainder of the project lifetime. Use survey data for each of the permanently

monumented monitoring cross-sections spanning the project excavation area in item 1.a. to determine the average existing conditions bed elevation. Use weighted averaging technique to determine average bed elevation for existing conditions. The redline elevation for that cross-section is 5.0 ft less than the average existing elevation.

First Year Excavation Phase Monitoring Procedure

7. Field survey-stake the permitted excavation area grading limits, or a uniform horizontal offset from the grading limit, for excavation guidance and setback compliance purposes. Stake the grading limit according to the horizontal setbacks in the Conditions of Approval, including: horizontal setbacks from existing toes of banks including banks of vegetated islands, from existing riparian tree driplines, and property boundaries. Stakes should be not more than 100 ft apart along the perimeter of the excavation area boundary and more closely spaced as may be necessary within areas with complicated excavation area limits, such as in the vicinity of multiple vegetated islands and braided channel sections within the South Excavation Area.
8. Check groundwater table elevations and determine excavation depth along length of excavation areas within each of the six (6) piezometers to determine the groundwater elevation profile along the length of the excavation area(s). The excavation depth cannot exceed the annual maximum depth as conditioned by the permit (2 ft). If the groundwater table elevation is at least 1.0 ft lower than the planned post-excavation trench bed elevation than planned excavation can commence. If not, then the planned excavation depth needs to be revised so that the post-excavation trench bed elevation is at least 1.0 ft higher than the groundwater table. For excavation guidance, mark so determined excavation depth so that they are plainly visible on the grading limit offset stakes surrounding the perimeter of the excavation area.
9. Continue logging monthly groundwater table soundings.

First Year Post-Excavation Monitoring Procedure

10. Re-survey truncated cross-sections for the portion (approx. 13 total) of the total 20 monitoring cross-sections that span the finished excavation area(s). Use traditional surveying digital theodolite or survey-grade GPS to survey the portion of each cross-section spanning the active low-flow channel and the excavation area, such as between the temporary cross-section endpoint monuments established in item 4. above.
11. Submit to TAC pre- and post-excavation survey data and monthly groundwater table elevation data, and other information required by TAC for compiling annual report for the mine project area and Subreach S-1.

Ongoing Annual Excavation Monitoring Procedure

Each subsequent year during the project lifetime the operator may elect to mine material or forego mining as would depend on multiple factors, including the proximity of the groundwater table to the current river bed or trench bed elevation, amount of material replenishment occurring within the trench bed during the previous winter, etc. In no case shall the mining depth exceed 2 vertical feet in any one excavation year. The project total maximum excavation depth (redline) shall not exceed 5 feet. In other words, the post-

excavation trench bed elevations should never be less than the redline elevation established in item 6. above. If the operator elects to mine during a given year, he/she must implement items 7. -11. above. If the operator does not elect to mine in a given year, he/she will not be required to collect and submit cross-section or groundwater elevation data to TAC in that year.

Each spring following a winter with reasonably large winter flows in Subreach S-1 as determined by the TAC, the TAC will conduct a field evaluation and spot elevation survey within all or part of Subreach S-1, including the Pankey mine site Salinas River excavation areas to evaluate the general level of sediment replenishment within the excavation areas, and the effectiveness of setbacks in minimizing bank erosion effects. If the TAC detects a deleterious level of bed elevation decline or bank erosion appears was induced by the mining activities, then it may, at its discretion require a cessation of mining until such time that bed elevations improve, or direct mitigation in the form of biotechnical bank stabilization and repairs at the affected sites. The TAC may also require repeat LiDAR data collection for all or part of Subreach S-1 according to degree of the observed channel changes and need for documenting the same as part of the ongoing Area-Wide Adaptive Management Plan.

The TAC will use its own periodic field observations and semi-annual cross-section data and monthly groundwater level monitoring data re. Subreach S-1 in conjunction with other similar data from other subreaches to prepare annual reports documenting the Pankey Project's compliance record, and long-term effects on groundwater table elevations, bed elevations, and bank erosion in Subreach S-1, including maintenance and monitoring of any biotechnical bank stabilization and repair work required as mitigation during the project lifetime.

The responsibility of evaluation of Project monitoring data and evaluating impacts and requirements for mitigation and adaptive management or adjustment of the Project's mining activities, including but not limited to, the annual maximum excavation depth, project maximum excavation depth (redline), minimum vertical setback from groundwater table elevation, and minimum horizontal setbacks from the toes of channel and island banks and riparian tree driplines, will rest solely with the TAC.

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